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THE MARINE ALGAE OF PERU

BY

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(WITH 66 PLATES AND 44 TEXT FIGURES)

INTRODUCTORY

The marine algae on which the following paper is chiefly based were secured by Dr. Robert E. Coker, now of the U. S. Bureau of Fisheries, while acting as fisheries expert to the Government of Peru in the years 1906, 1907, and 1908. Though the collecting of seaweeds was incidental to his study of the fishery resources of Peru, Dr. Coker's careful and discriminating attention to the marine plant life resulted in his bringing back to the United States one of the most comprehensive and instructive collections of algae ever made in South America. The specimens were all preserved with the aid of formaldehyde and were in excellent condition for showing the natural habit of the plants and their more important anatomical and morphological characters. This mode of preservation, however, often modifies or destroys the natural color of marine algae, especially of the Rhodophyceae, so that in the descriptions that follow it has sometimes been necessary to omit all reference to color.

Inasmuch as the coast on which Dr. Coker made his collections lies wholly within the tropics (approximately from 3½° S. to 17° S.), one might very naturally expect that his specimens would be found to belong to genera or possibly to species that are commonly thought of as peculiar to tropical and subtropical waters, but such is the case in a surprisingly small degree. It appears that the only part of the coast of Peru along which a conventionally "tropical" fauna and flora is found is a strip about 32 kilometers long at the extreme north near the mouth of the Río Tumbes on the Gulf of Guayaquil. For the remaining 2250 kilometers the water of

* Prepared at the request of the Ministerio de Fomento of the Peruvian Government as a contribution to the knowledge of the aquatic resources of Peru.

the ocean is cold and its vegetation is of a pronounced "temperate" character, the larger and more conspicuous algae belonging to such genera as *Macrocystis*, *Lessonia*, and *Eisenia*. The following summary of temperature conditions in the sea along the Peruvian coast, written by Dr. Coker,* is instructive:

"Untropical as is the coast of Peru in its aspect as described above, it is equally so as regards the temperature of the ocean water. There is no more significant feature of the coast than the Humboldt or Peruvian current which flows northward and northwestward along the west coast of South America, bringing the cold antarctic waters down to the equatorial region. To find upon the coast of the United States a summer temperature of the ocean water corresponding to that of Callao at 12° S. one would go to about the latitude of New York on the Atlantic side (41° N.) or Monterey on the Pacific (36° N.). The Peruvian current, in conjunction with other factors, particularly the constancy of the winds on the coast, produces a relative uniformity of temperature conditions. There is little variation in the water temperature from hour to hour during the day, little difference from month to month during the year, and a relatively small change from latitude to latitude. It is probable that such variations as are found are due more to very local conditions, or to the swinging of the current, than to seasonal changes or differences of latitude. At Callao (12° S.) the water in early summer was at 15–19° C. (59–66° F.) and in early winter from 16.5 to 19° C. (61–66° F.); at Paita (5° S.), in April, records from 15.5 to 20.5° C. were taken, with an average of 17.5° C. (63.5° F.); while at Mollendo (17° S.), more than a thousand miles to the south—or as far away from Paita as New York from Miami, Fla.—the midwinter temperature was 16° C. (61° F.). This current leads the fishermen to go southward from the port instead of northward, if a prompt return journey is desired, and its supposed swinging movements are of further significance, as it causes certain pelagic fishes to approach or recede from the coast.

"With such low water temperatures a tropical fauna is, of course, absent. Corals are wanting, sponges nearly so, and the general character of the fauna and flora of the region is such as would ordinarily be found in much higher latitudes."

* Bull. Bur. Fisheries **28**: 337. 1908. More detailed reports of more than 300 observations of ocean temperatures along the Peruvian coast have been published by Dr. Coker in several papers in the Boletin del Ministerio de Fomento [Lima] during the years 1908–1910.

ECONOMIC POSSIBILITIES

The possible economic importance of the marine algae has been emphasized of late by the investigations that have been carried on by the U. S. Department of Agriculture as to their use as a source of "potash" for agricultural fertilizers. The kelps of the Pacific coast of the United States in particular are the subject of several taxonomic, biologic, and chemical papers published in a recent report on "Fertilizer Resources of the United States."* In the letter of transmittal accompanying this report, Hon. James Wilson, Secretary of Agriculture, remarks:

"But in the giant kelps of the Pacific coast there is a potential source of potash salts which can certainly yield annually some three or four times the amount now used in this country, and under the best management might even rival the famous Stassfurt deposits. It is regarded as a very conservative estimate to put the annual yield of potassium chloride from the Pacific kelps at upward of 1,000,000 tons, worth at present prices nearly $40,000,-000."

To a similar statement, Milton Whitney, Chief of the Bureau of Soils, adds: "Moreover, it should be perfectly feasible to cover most, if not the entire, cost of production of this vast 'crop' by the iodine and other by-products produced simultaneously." Dr. J. W. Turrentine (loc. cit. 230, 231) quotes Balch's chemical analysis of the bulb of *Pelagophycus Porra* of the southern Californian coast, showing that 48 per cent. of its dry weight consists of potassium chloride. Dr. F. K. Cameron (loc. cit. 42) states that *Nereocystis Luetkeana*, which is the principal kelp of the Puget Sound region and occurs in abundance also farther south, has an average content of potassium chloride amounting to 30–35 per cent. of its dry weight, while *Macrocystis pyrifera*, which probably excels all the other kelps of the Pacific coast in the collective bulk of its growth, is about equally rich in this valuable compound.

Dr. Coker's notes, specimens, and photographs (see PLATE 18, FIGURE A) indicate that *Macrocystis* and other large seaweeds (*Lessonia* and *Eisenia*) are abundant on certain parts of the coast of Peru, and it is possible that these seaweeds will sometime prove important as a source of "potash" and will thus supplement the nitrogenous guanos which have brought large revenues to Peru

* Senate Document No. 190, 62d Congress. 1912.

in the past and the old deposits of which are now approaching exhaustion.*

HISTORIC AND BIBLIOGRAPHIC

So far as the present writer has been able to determine from the accessible literature, the first collectors to bring marine algae from the coasts of Peru were Alexander von Humboldt and Aimé Bonpland, who visited Huanchaco,† Callao, etc., in the latter part of the year 1802. As early as 1808, they had described and figured (Pl. Aequin. **2**: 7. *pl. 68;* 9. *pl. 69*) as two new species of the genus *Fucus* two Peruvian plants that are now identified with *Macrocystis pyrifera*. Nine species of Peruvian algae, reducible to eight, collected by Humboldt and Bonpland, were afterwards listed in their "Nova Genera et Species Plantarum" (**7**: 418. 1825). Their specimens included the original materials on which the elder Agardh had founded the species now known as *Glossophora Kunthii*, *Gymnogongrus furcellatus*, and *Centroceras clavulatum*.

The next botanists to collect algae on the shores of Peru appear to have been J. S. C. Dumont d'Urville, second in command, and R. P. Lesson, naturalist, of the French corvette *La Coquille* in its voyage around the world, who visited Peru in February and March, 1823.‡ The algae of this expedition were described and in part illustrated by Bory de St.-Vincent, and his classic work§ is of fundamental importance in studying the marine plants of the west coast of South America. In this volume Bory

* Coker, R. E. The fisheries and the guano industry of Peru. Bull. Bur. Fisheries **28**: 335–365. *pl. 12–17.* 1908.

† The spelling "Guanchaco" is used by Humboldt and later by Agardh in referring to algae presumably collected at this place.

‡ The d'Urville specimens of algae from Chile and Peru in the herbarium of Bory de St. Vincent, preserved at the Muséum d'Histoire Naturelle of Paris, are inscribed "1825" in Bory's hand, as if that were the date of collection, but that is apparently the date of his receiving the specimens from d'Urville.

§ Voyage autour du monde, exécuté par ordre du Roi, sur la corvette de Sa Majesté, *La Coquille*, pendant les années 1822, 1823, 1824 et 1825. Botanique, Cryptogamie. 4to. 1–96. 1827; 97–200. 1828; 201–300. 1829 (dates acc. to Sherborn & Woodward, Jour. Bot. **39**: 206. 1901). In the folio atlas, "1826," plates 1–24 relate to the algae. The text and plates relating to the algae, the plates in duplicate, colored and uncolored, were published separately, in folio, in 1829, under the title "Histoire des hydrophytes, ou plantes agames des eaux, recoltées par MM. d'Urville et Lesson, dans leur voyage autour du monde, sur la corvette de Sa Majesté, *La Coquille*," etc.

definitely ascribes to Peru nine species of marine algae, which are probably reducible to eight, but he describes and figures several from Chile which have since been found to extend to Peru.

In April, 1830, Alcide d'Orbigny landed at the seaport Arica, then in Peru, though now under the control of Chile, but we do not know that he collected any algae there. However, in the summer of 1833 he explored the region of Callao, where he secured a number of species of algae, including several that were new to science. Abel Aubert du Petit-Thouars, captain of the frigate *Vénus* and afterwards a vice-admiral in the French navy, was at Callao in May and June 1837 and again in May and June 1838 and made collections of seaweeds there. These Peruvian algae collected by d'Orbigny and by du Petit-Thouars were reported upon by Montagne in 1839 in his "Florula Boliviensis,"* in which twenty-eight species of algae are attributed to the coast of what is now Peru.

In 1839, the year of the appearance of Montagne's "Florula Boliviensis," J. N. von Suhr published a paper entitled "Beiträge zur Algenkunde,"† in which two species from Peru are described as new and in the following year, in another paper under the same title,‡ three more Peruvian species are added.

Charles Gaudichaud-Beaupré visited Callao and vicinity on the French frigate *L'Herminie* in 1831 (?), and again, in July 1836, as naturalist of the corvette *La Bonite*, he made collections of algae at Callao and Paita. The algae secured on both of these visits were included in Montagne's report|| on the cryptogamous plants collected on the voyage of the Bonite. In this work sixteen

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* Voyage dans l'Amérique Méridionale (le Brésil, la République Oriental de l'Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou) exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832 et 1833, par Alcide d'Orbigny. Tome septième. Seconde partie.

† Flora **22**: 65–75. *pl. 1–4*.

‡ Flora **23**: 257–265; 273–282; 289–298.

|| Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la corvette *La Bonite* commandée par M. Vaillant. Botanique. Tome premier. Cryptogames cellulaires et vasculaires. 8vo. 1844–1846. According to Sherborn & Woodward (Jour. Bot. **39**: 206. 1901) 1846 is the true date of publication of all of the text. The folio atlas, with 150 plates, bears no date on its title page; Sherborn & Woodward give its date as "1846–49."

species of Peruvian algae are mentioned, of which four are proposed as new.

The United States Exploring Expedition under the command of Lieutenant (afterwards Admiral) Charles Wilkes visited Peru in June and July 1839 and about 820 species of plants are said to have been collected there by members of the party. In the Columbia College Herbarium there are Peruvian specimens of *Ulva Lactuca rigida*, *U. fasciata costata*, *Macrocystis pyrifera Humboldtii*, and *Gigartina Chauvinii*, with Wilkes Expedition labels, though no Peruvian material is mentioned in Bailey and Harvey's account* of the algae of this expedition.

In various phycological works of F. T. Kützing, published from 1843 to 1869, a considerable number of Peruvian algae were described as well as others from Chile that have a direct bearing upon the marine flora of Peru. And the same is to be said also of the numerous important phycological works of J. G. Agardh, ranging as to date from 1841 to 1901. These and other works in which we have found original references to Peruvian algae will be cited in the following pages.

The paper in which more of the marine algae of Peru are mentioned than in any other up to the present time (with the exception of De-Toni's "Sylloge Algarum") is Antonio Piccone's account of the algae of the voyage of the Vettor Pisani,† published in 1886. In this and the supplementary paper‡ published three years later, thirty-two species (excluding diatoms) are attributed to Peru.

In De-Toni's "Sylloge Algarum,"§ if one includes several "species inquirendae" and some others that are reducible to synonymy and if one at the same time excludes several that have been reported only from outside the present political boundaries of the republic, about sixty-five species of marine algae may be found ascribed to Peru. Since the publication of the various vol-

* Wilkes Exped. **17**: 155–192. 1862. For notes on this report, see F. S. Collins, "The botanical and other papers of the Wilkes Exploring Expedition" (Rhodora **14**: 57–68. 1912).

† Alghe del viaggio di circumnavigazione della Vettor Pisani. 8vo. 1–97. *pl. 1, 2.* Genova, 1886.

‡ Nuova alghe del viaggio di circumnavigazione della "Vettor Pisani." Mem. R. Accad. Lincei IVa. **6**: — (1–57). 1889.

§ Vols. 1, 3–5. 1889–1907.

umes of De-Toni's Sylloge, the only paper dealing directly with Peruvian marine algae, so far as we have been able to discover, is a brief one by R. Pilger.*

The algae of the Galapagos Islands, lying only five hundred or six hundred miles west of the coast of Ecuador, are of interest in connection with those of Peru, but the lists of Galapagos algae published by Piccone (loc. cit.) and by Farlow† would seem to indicate that the marine floras of these two regions have few species in common.

NUMBER OF SPECIES

A review of the literature relating to the marine algae of Peru leads to the opinion that, previous to Dr. Coker's visit, about 68 valid species belonging to this group had been reported as occurring within the present limits of the country. These were distributed in classes as follows: Cyanophyceae, 1; Chlorophyceae, 13; Phaeophyceae, 5; Rhodophyceae, 49. In Dr. Coker's Peruvian collections we find 96‡ species, representing 67 genera. Of these 96 we are venturing to describe 28 as new. The large proportion of novelties is due in part to the inclusion of a number of inconspicuous epiphytes and endophytes, which have offered an essentially unworked field so far as South America is concerned. Dr. Coker was, we believe, the first collector of Peruvian algae to make use of a dredge, and his finding of certain species that apparently had been overlooked by his predecessors may be due to that fact. About 27 of the apparently valid species of seaweeds hitherto attributed to Peru seem to have escaped his attention, so that there are good grounds for believing that the shores of the Peruvian republic may claim at least 123 species of marine algae, a number that surely will be much increased by future explorations. The incidental efforts of a fisheries expert on a coast that had previously been visited by several botanists have resulted in almost doubling the number of algae known from the region—a noteworthy achievement for any collector and particularly remarkable for one who was professedly neither a phycologist nor a

* Kleinere Beiträge zur Kenntnis der Meeresalgen I. Hedwigia **48**: 178–183. *pl. 7.* 1908.

† Proc. Am. Acad. **38**: 89–98. 1902.

‡ Including 2 that are here referred to genus only.

botanist. The Peruvian species other than those met with by Dr. Coker are mentioned by name at least, in the following pages, though it may hardly be assumed that none has been overlooked. Of the total of 123 species, 8 are Cyanophyceae, 23 are Chlorophyceae, 18 are Phaeophyceae, and 74 are Rhodophyceae.

NOMENCLATURE

The nomenclature of the present report may impress some of its readers as being inconsistent, personal, and arbitrary rather than always conforming rigidly and solely to either the "American Code"* or the "Vienna Rules" with their Brussels Amendments.† In partial extenuation of this circumstance it may be pleaded that the best rules of nomenclature yet devised leave a good deal to individual judgment as to their interpretation and application and that unless some court of last resort in such matters is established and generally recognized, the personal element in the interpretation of rules must always lead to a certain diversity in usage. In the matter of recognizing priority of publication as affecting the choice of specific names, there is now little difference in practice among the taxonomic botanists of the world and our course in this respect will, we believe, not be considered peculiar. In the matter of recognizing the claims of priority as affecting generic names, there has been more divergence of opinion. The Brussels Congress adopted a list of "nomina conservanda" among the generic names of the algae, these being mostly long-established names which it is sought to perpetuate, regardless of certain defects in their title. But, as the Brussels Congress neglected to name a species which should serve as the "type" of each genus thus placed outside the scope of the law, it is not always clear just for what a given generic name shall be "conserved." The so-called "American Code" recognizes no "nomina conservanda," but does propose a scheme for the typifying of genera. In the following pages we have tried to decide each case on its individual merits. When it has been simply a matter of clear-cut priority, unembarrassed by other considerations, as, for example, in the

* Bull. Torrey Club **31**: 249–261. 1904; **36**: 55–63. 1909.

† Règles internationales de la nomenclature botanique adoptées par le Congrès International de Botanique de Vienne 1905. Deuxième edition mise au point d'après les décisions du Congrès International de Botanique de Bruxelles 1910. Jena. 1912.

case of *Neurocarpus* vs. *Dictyopteris* and *Halyseris*,* we have not hesitated to give preference to the oldest name, beginning with Linnaeus' "Species Plantarum," in accordance with the provisions of the "American Code," without regard to the list of nomina conservanda of the Brussels Congress. On the other hand, there are many cases, as, for example, most of the new generic names imposed upon algae by Rafinesque, in which, in default of authentic specimens, the correct application of the name must remain involved in doubt, or in which, perhaps, the application may seem clear to one phycologist and obscure to another equally competent to judge. In all such cases we have never intentionally sacrificed certainty to uncertainty. In several such cases, in some others that have appeared unusually complicated and of doubtful solution, and in certain others in which a drastic application of the American Code has seemed to lead to confusing and unhappy results, we have felt relieved to find at least a temporary solution of our difficulties in the list of "nomina conservanda" prepared by the Brussels Congress. We confess also to a personal prejudice against the revival of ancient adjectival generic names such as *Amphibia*, *Hyalina*, *Bifida*, etc., of Stackhouse and the *Vertebrata* of S. F. Gray. The fact that a few not altogether dissimilar names have secured a foothold in the language of botany and have become classic does not seem an adequate excuse for the admission of a small host of others which, by common consent, have been almost universally ignored.

ACKNOWLEDGMENTS

If the present attempt to describe and enumerate the marine algae of Peru possesses any degree of accuracy, it is due in large measure to the generous cooperation of the owners or custodians of the original South American materials on which numerous species described by C. Agardh, Bory, Montagne, J. Agardh, Kützing, and others were based. Through the helpful courtesies of the fortunate possessors of these original specimens we have been able to examine the types or at least photographs of the types of nearly all of the species, South American and otherwise,

* In this particular case, the Brussels Congress named *Dictyopteris* as the *nomen conservandum*, even though the preponderance of "usage" during the past fifty years eems to have favored *Halyseris*.

which seemed to have a direct bearing upon the determination of Dr. Coker's material. In this connection we are especially indebted to the never-failing patience and courtesy of Messrs. L. Mangin and P. Hariot of the Muséum d'Histoire Naturelle of Paris, where the specimens described by Bory and by Montagne are preserved, and of Mme. Dr. A. Weber-van Bosse, of Eerbeek, Holland, the possessor of the historic Kützing herbarium. We are under obligations also to Professor Dr. O. Nordstedt of the University of Lund, Sweden; Lt.-Col. Sir David Prain and Mr. A. D. Cotton of the Royal Botanic Gardens, Kew, England; Mr. A. Gepp of the British Museum (Natural History); to Drs. A. Voigt and W. Heering of the Hamburgische Botanische Staatsinstitute, Hamburg, Germany; Dr. R. Pilger of the Königl. Botanische Garten und Museum, Berlin-Dahlem; Professor Dr. N. Wille of the University of Kristiania; Professors W. G. Farlow and Roland Thaxter of Harvard University, Cambridge, Massachusetts; Dr. Achille Forti of Verona, Italy; and others.

NEW YORK BOTANICAL GARDEN

CYANOPHYCEAE

Family CHROOCOCCACEAE

PLACOMA Schousb.; Born. & Thur. Not. Alg. 4. 1876

PLACOMA sp.

Thallus forming pulvinate or irregularly hemispheric, simple or sparingly lobed or corrugate, usually isolated vesicles mostly 0.5–1.5 mm. in diameter; walls of the vesicles 25–50 μ thick, with occasional scattered cells occupying the central slime-filled cavity, the outer jelly 8–14 μ thick; cells (endochrome) after division concavo-hemispheric or tetrahedral-hemispheric, later reniform, lunate, oblong-ellipsoidal, or subspheric, 5.5–13 μ in long diameter, the gelatinous walls diaphanous, rather soft and confluent.

On a water-born basal fragment of *Prionitis decipiens*, in company with other epiphytes, washed ashore, La Punta, region of Callao, Dec. 6, 1906, *Coker 23 p.p.*

Near the rupicolous *Placoma vesiculosa* Schousb. of northern Africa and southern Europe, yet seems to differ in the smaller simpler thallus, the thinner wall of the vesicle (100–130 μ thick in *P. vesiculosa* according to Bornet's figures*), and the softer more confluent and less well-defined cell walls. The color is green with a slight trace of blue, but this character may have been modified by the preserving fluid (formalin). The fresh-water *Placoma africana* Wille has much smaller cells and a more parenchymatous structure.

We have had no authentic specimens of *Placoma vesiculosa* for comparison, our Peruvian material is scanty, and we would not venture at this time to assign to it any specific name.

CHLOROGLOEA Wille, Nyt Mag. Naturvid. 38: 2–5. 1900

CHLOROGLOEA TUBERCULOSA (Hansg.) Wille, loc. cit.
pl. 1. f. 1–6

Palmella (?) *tuberculosa* Hansg. Sitzungsb. Königl. Böhm. Ges. Wiss. 1892: 240. *pl. 6. f. 9.*

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* Born. & Thur. Not. Alg. *pl. 1. f. 6–10.*

On *Gymnogongrus furcellatus*, Callao, December 27, 1906, *Coker 17 p.p.;* on the same, Chincha Islands, June 18, 1907, *Coker 193 p.p.;* on the lamina of *Lessonia nigrescens*, Pescadores Islands, region of Ancón, February 12, 1907, *Coker 09150 p.p.* (FIGURE 1); also, in minute scattered colonies, on *Chaetomorpha* and *Cladophora*, Chincha Islands, June 18, 1907, *Coker 196 p.p.*

The original *Palmella* (?) *tuberculosa* was described from the Adriatic Sea, where it is said to form colonies hardly 1 mm. broad on species of *Gelidium*, *Ceramium*, *Polysiphonia*, *Cladophora*, etc. Later, it was described by Wille under a new generic name as occurring in southern Norway on the stipes of *Laminaria digitata* and on *Rhodochorton Rothii*.*

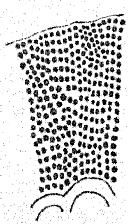


FIGURE 1. *Chlorogloea tuberculosa* (Hansg.) Wille. A widely expanded form on lamina of *Lessonia nigrescens*, Pescadores Islands, *Coker 09150 p.p.;* a vertical section, enlarged 675 diameters.

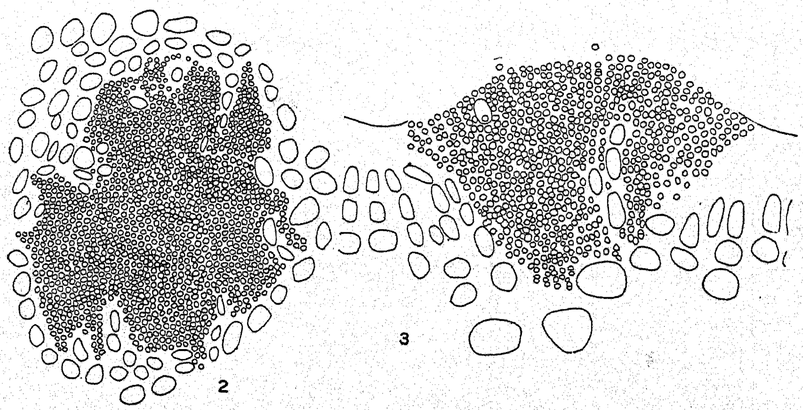
We have not been able to obtain authentic material of *Palmella* (?) *tuberculosa* Hansgirg, but, through the courtesy of Professor Wille, we have seen his *Chlorogloea tuberculosa* on stipes of *Laminaria*. In the Peruvian specimens on *Chaetomorpha*, *Cladophora*, and *Gymnogongrus*, the colonies are rarely as much as 1 mm. broad; they are often 150 μ broad or less, are 30–125 μ high, and are commonly intermingled with other epiphytes. But on the *Lessonia* it seems sometimes, at least, to have uninterrupted opportunity for extension and here some such specific name as *expansa* would be more apt than *tuberculosa*. On the *Lessonia* it forms a compact, obscure, closely adherent, plane, submembranaceous stratum 20–50 μ thick and of

* More recently, Setchell and Gardner (Univ. California Publ. Bot. 1: 182. 1903) have, with some doubt, identified with these plants the epiphyte on *Cladophora* from British Columbia distributed by Tilden as *Pringsheimia scutata* f. *Cladophorae* (Tilden, Am. Alg. 382) and this opinion has subsequently been adopted by Tilden (Minnesota Alg. 1: 46. 1910), but we find nothing agreeing with our Peruvian plants or with Hansgirg's figure in the Columbia University copy of Am. Alg. 382. Hansgirg's figure and description call for vertical rows of about 20 cells, while in Miss Tilden's plant, as we have seen it, the cells are mostly unistratose; the cells average considerably larger than the 1–1.5μ of Hansgirg's description and, as intimated by Setchell and Gardner, there are intermingled still larger cells that have the appearance of being conidangia. Like Setchell and Gardner, we find nothing resembling *Pringsheimia* in Am. Alg. 382, but we suspect that the name "*Pringsheimia scutata* f. *Cladophorae*, n. f." was intended to apply to some species of *Dermocarpa*.

indefinite extent, the patches being sometimes 15 mm. or more in diameter; the cells are mostly 1–2.5 μ in the longer diameter, are subglobose or oblong, 1–2 times as long as broad, in obvious vertical rows and compactly imbedded in a rather inconspicuous jelly; the color of the colonies as they come to us preserved in fluid is a dilute yellowish green, though individual cells show a bluish tinge under the higher powers of the microscope; the structure of the protoplast is clearly of a Cyanophyceous character. In the thickness of the stratum and in the number of cells in the rows, Dr. Coker's plants apparently resemble the original figures by Hangsirg more than the later figures by Wille. It may, however, be remarked that we have been unable to see sheaths for individual cell rows so distinctly as figured by these authors.

Chlorogloea endophytica sp. nov.

Forming endophytic yellowish-green corticicolous colonies, these mostly 20–110 μ broad and suborbicular or irregularly stellate or radiate in surface view, penetrating thallus of host about 30–170 μ and often a little protuberant; cells somewhat angular, ellipsoidal or subspheric, 0.7–2.5 μ (mostly 1–1.5 μ) in diameter,



FIGURES 2 and 3. *Chlorogloea endophytica* M. A. Howe, in cortex of *Leptocladia peruviana*, Bay of Sechura, *Coker 157 p.p.*, enlarged 675 diameters. 2, a colony viewed from above; 3, a similar colony in vertical section.

in rather indistinct vertical or somewhat radial rows, at length becoming mutually free and irregularly disposed in dense swarms. [FIGURES 2 and 3.]

Endophytic in the cortex of *Leptocladia peruviana*, "dredged in

five fathoms," Bay of Sechura, April 8, 1907, *Coker 157 p.p.* (type) —associated and occasionally intermingled with *Hyella infestans;* in cortex of the stipe of *Chondrus canaliculatus*, Chincha Islands, June 18, 1907, *Coker 192 p.p.*, here also associated with *Hyella infestans*. *Chlorogloea endophytica* differs from *C. tuberculosa* (Hansg.) Wille in its endophytic habit and in its less distinctly seriate arrangement of the cells, the softer gelatinous walls soon allowing the cells to become inordinate; though the cells are at first chiefly in rows, the cell divisions apparently occur in various planes.

The colonies in the cortex of the *Chondrus* are the larger and better developed, penetrating to a depth of 100–170 μ, while those in the *Leptocladia* penetrate only 30–65 μ. Those in the *Leptocladia* were the first to be seen and studied and furnished the material for our figures; otherwise, the specimens inhabiting the *Chondrus* would have been named as the type.

Family CHAMAESIPHONACEAE

HYELLA Born. & Flah. Jour. de Bot. **2**: 162, 163. 1888

HYELLA CAESPITOSA Born. & Flah. loc. cit. 162; Bull. Soc. Bot. France **36**: clxv. *pl. 10. f. 7–9; pl. 11.* 1889

In old shells, associated with *Plectonema terebrans* Born. & Flah. and various other small encrusting and perforating algae, dredged near San Lorenzo, region of Callao, February 5, 1907, *Coker 59 p.p.;* in a piece of shell with *Gomontia arhiza* Hariot, in one fathom of water, Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09639 p.p.*

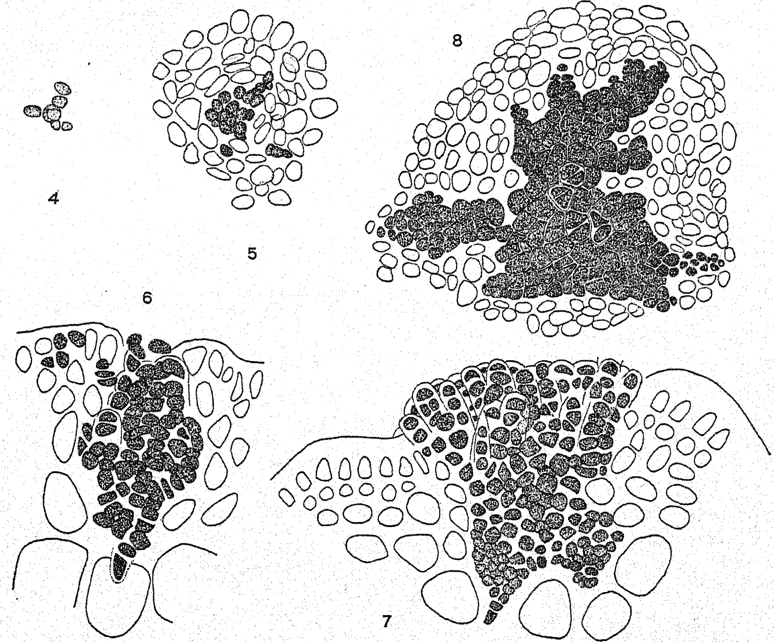
Mastigocoleus testarum Lag., which is elsewhere commonly associated with *Hyella caespitosa* and with *Gomontia*, may also occur, but has not been detected with certainty in this material.

Hyella infestans sp. nov.

Forming endophytic, bluish-green, slightly elevated or subpapilliform corticicolous colonies, these mostly 30–90 μ broad and suborbicular or irregularly stellate or radiate in surface view, penetrating thallus of the host about 50–70 μ; filaments usually distinct in exterior half of the colony, erect or obliquely ascending,

5–9 μ broad, crowded, forming at the surface, in the central portions, a pseudoparenchyma with irregularly 4–6-angled cells; cells of the filaments uniseriate or with occasional longitudinal or oblique divisions, the distal hemispheric or crescentic-discoid; cells of the median and basal parts of the colony dividing freely in various planes and irregularly arranged, often only 3–4 μ in diameter, angular or rounded, now and then aggregated in ovoid or botryoid basal lobes, the colony commonly showing at its base one or more free penetrating filaments; reproduction by the setting free of exposed peripheral cells. [FIGURES 4–8.]

In the cortex of *Leptocladia peruviana*, "dredged in five fathoms" in the Bay of Sechura, *Coker 157 p.p.*—associated and sometimes intermingled with *Chlorogloea endophytica.* It is com-



FIGURES 4–8. *Hyella infestans* M. A. Howe, in cortex of *Leptocladia peruviana*, Bay of Sechura, *Coker 157 p.p.*, enlarged 675 diameters. 4, 5, 8, colonies of various ages, seen from above; 6, 7, colonies in vertical or anticlinal section.

monly accompanied also, in the superficial parts of the colony, by cells that are somewhat larger and redder than the ordinary peripheral cells of the cortex of the host; these are commonly cells of the host that have been stimulated in some way by the presence

of the Cyanophyceous endophyte, but are sometimes the cells of a Bangiaceous endo-epiphyte—*Erythrocladia endophloea*. *Hyella infestans* has been observed also in association with *Chlorogloea endophytica* in the stipe of *Chondrus canaliculatus* from the Chincha Islands, *Coker 192 p.p.*

Conidangia have not been observed with certainty and we doubt if they occur, at least in the material at hand. The small cells of *Chlorogloea endophytica*, which sometimes occur in the *Hyella* colonies, we at first suspected to be conidia of the *Hyella*, but they are yellowish-green, while the *Hyella* is blue-green, and we believe the two to be quite independent of each other, having been able to follow each from a few-celled stage to the mature colony.

Hyella infestans is doubtless a close relative of *Hyella endophytica* Börgesen (Bot. Faeröes **2**: 525. *f. 109*. 1902), from which it appears to differ in the more compact subparenchymatous colony with its surface more superficial or exserted, in the relatively broader, more discoid, and usually larger cells of the filaments, and in the apparent absence of conidangia.

DERMOCARPA Crouan, Ann. Sci. Nat. Bot. IV. 9: 70. 1858

Sphaenosiphon Reinsch, Contrib. Alg. et Fung. 15. 1875.

DERMOCARPA PRASINA (Reinsch) Born. & Thur. Not. Alg. 76. *pl. 26. f. 6–9*. 1880

Sphaenosiphon prasinus Reinsch, loc. cit. 17. *pl. 26. f. 1*.
Sphaenosiphon incrustans Reinsch, loc. cit. *pl. 26. f. 3*.
Dermocarpa prasina var. *incrustans* Holmes & Batters, Ann. Bot. **5**: 67. 1891.

On *Streblocladia spicata*, *Prionitis decipiens*, and *Cladophora fascicularis*, from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*; on *Chaetomorpha cartilaginea* and *Cladophora fascicularis*, from surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 196 p.p.*, associated with more numerous thalli of *Erythrotrichia polymorpha*, to which (in our more or less decolorate material) it occasionally bears a slight superficial resemblance.

In general habit of growth these Peruvian specimens are per-

haps more suggestive of Reinsch's figures of *Sphaenosiphon incrustans* than of his figures of *S. prasinus*. The specimens on *Chaetomorpha* and *Cladophora* from the Chincha Islands are remarkable for their color, which is a light bright green, sometimes with a slight tinge of blue. The color in these may have undergone some change owing to the action of the formaldehyde solution in which the plants are preserved, though certain other associated Cyanophyceae retain a pronounced bluish color. It is to be noted, too, that the specific name *prasina* and the original description of the species call for a dominant degree of green, though all of the specimens labeled *D. prasina* that we have examined have seemed to us to be decidedly blue. It may be observed, also, that the epiphyte on *Sphacelaria*, from which most of Reinsch's figures were drawn, may fairly be considered the type of the species, rather than the epiphyte on *Catenella* from which the sixth and last of Reinsch's figures and all of the figures subsequently published by Bornet and Thuret were drawn. In the way of further description of the greenish form (*196 p.p.*) it may be added that the colonies are irregularly diffluent or pulviniform or suborbicular, and are mostly 80–500 μ in diameter; the young cells are discoid and polygonal, 3–5 μ in diameter, often showing more or less distinct rows at the margin of the colony; the mature cells are short-prismatic, subcylindric, clavate, or trumpet-shaped, 13–27 $\mu \times$ 6–14 μ, truncate, rounded-obtuse; or subacute; the cell wall is thin (about 2 μ thick). The cells show a great variety in form and size and commonly a striking differentiation between sterile and fertile cells, but these characteristics seem to obtain also in the genuine *D. prasina*. In the younger conditions the small cells at the margins are often in rather easily recognizable rows, which would appear to indicate vegetative division and would perhaps be considered by some a sufficient ground for placing the plant under the generic name *Xenococcus*, but this alleged distinction between *Xenococcus* and *Dermocarpa*, in our opinion, does not exist in nature. Vegetative divisions appear to occur in both.

Family OSCILLATORIACEAE

"*Lyngbya ferruginea* var.? Ag. . . . An species distincta?" has been reported from the Peruvian shores by Montagne (Fl. Boliv. 3.

1839). *Lyngbya ferruginea* Ag. is made a synonym of *L. aestuarii* by Gomont (Ann. Sci. Nat. Bot. VII. **16**: 127. 1892) but he apparently does not cite any Peruvian specimen in showing the distribution of this species.

We have observed two or three undetermined species of Oscillatoriaceae in minute quantity attached to various Peruvian algae (e. g. *Prionitis decipiens*) in Dr. Coker's collections.

Family SCYTONEMATACEAE

PLECTONEMA Thuret, Ann. Sci. Nat. Bot. VI. **1**: 375, 379. 1875

PLECTONEMA TEREBRANS Born. & Flah. Bull. Soc. Bot. France **36**: clxiii. *pl. 10. f. 5, 6.* 1889

In old shells, with *Hyella caespitosa* Born. & Flah., etc., dredged near San Lorenzo, region of Callao, Feb. 5, 1907, *Coker 59 p.p.*

The filaments are 0.8–1.4 μ in diameter, usually much contorted, and rarely branching.

CHLOROPHYCEAE

Family ULVACEAE

ULVA L. Sp. Pl. 1163. 1753

ULVA LACTUCA RIGIDA (Ag.) Le Jolis, Liste Alg. Mar. Cherbourg 38. 1863

Ulva rigida Ag. Sp. Alg. 410. 1822. J. Ag. Till Alg. Syst. 3: 168. *pl. 4. f. 119–122.* 1882.

Phycoseris rigida Kütz. Tab. Phyc. **6**: *pl. 23. f. II.* 1856.

In beach drift, La Punta, region of Callao, December, 1906, *Coker 23 p.p.;* on *Glossophora Kunthii*, in beach drift, same locality, Jan. 25, 1907, *Coker 32 p.p.* (young); growing in tide-pool, same locality and date, *Coker 36;* abundant on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 193 p.p.;* in same locality, July 13, 1907, *Coker 492 p.p.;* from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.;* Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09640 p.p.;* on rocks in the surf, Mollendo, August, 1908, *Coker 565 p.p.*

The thallus in the mature Peruvian plants is mostly 80–120 μ

thick, becoming 200–750 μ towards the stiff crisp rhizoid-filled basal parts. The cells in a cross section are 1–3 times higher than broad. In most of Dr. Coker's specimens the two layers separate very easily. We at first suspected that this tendency to separate might be due to four or five years' keeping in a formaldehyde solution, but it has been discovered only in the specimens that we have identified with the *rigida* form while in specimens that we have referred to the *latissima* form and to *U. fasciata*, preserved in the same way, there is no trace of this peculiarity. In one case (*193*—*U. Lactuca rigida* and *U. fasciata costata*) the forms with the easily separable and firmly coherent layers occur under a single collection number, in which case the general mode of handling as well as the character of the preserving medium may fairly be presumed to have been essentially identical for both.

Ulva Lactuca rigida was collected at Callao (in 1839) by the Wilkes Expedition according to a specimen in the Columbia College Herbarium, under the name *Ulva latissima*.

"*Ulva umbilicalis*" was attributed to Paita, Peru, by Bory (Voy. Coquille, Bot. Crypt. 188, 189. 1828); *Ulva Lactuca* has been reported from Callao by Montagne (Fl. Boliv. 5. 1839); Piccone (Alg. Vettor Pisani 21, 23. 1886) has recorded *Ulva myriotrema* Crouan from the Callao region and *Ulva fasciata lobata* (Kütz.) from Paita; we have not seen any of these specimens but suspect that we should place them all with *Ulva Lactuca rigida*.

ULVA LACTUCA LATISSIMA (L.) DC. Fl. Fr. **2**: 9. 1805

Ulva latissima L. Sp. Pl. 1163. 1753. J. Ag. Till Alg. Syst. 3: 164. 1882.

Dredged in Ancón Bay in 9 fathoms, on a mud bottom, Feb. 13, 1907, *Coker 90 p.p.*; in the surf, Lobos de Tierra, Apr. 2, 1907, *Coker 151 p.p.*; in lagoon at La Puntilla, Bay of Paracas, region of Pisco, June 29, 1907, *Coker 09619 p.p.*

The specimens grouped together under this varietal or form name are diversified in form, size, and color, but agree in having a thin thallus (13–40 μ thick) and in having cells that are broader than high or subquadrate in section. One of the two *Ulva* fragments collected under no. 09619 is exceedingly thin (13–15 μ) and adheres very firmly to paper, suggesting in both respects certain species of *Monostroma*, but it is distromatic.

Ulva fasciata costata forma nova

Ulva fasciata Bory, Voy. Coquille, Bot. Crypt. 190. 1828. Vix Delile.

Thallus or its main divisions narrow and elongate (usually 30–70 cm. × 0.5–2 cm.), crisped and ruffled and often spirally contorted, sometimes pinnatifid near base, more or less distinctly costate, the costa mostly 120–150 μ thick, twice as thick as the remaining lamina, the margins sinuate or obscurely dentate, the marginal cells commonly protuberant (i. e., margins commonly concave or emarginate in a cross section); zoosporangia (?) or gametangia (?) in darker-green marginal bands. [PLATE 1; PLATE 2, FIGURES 10–23.]

Chincha Islands, on surf-washed rocks, June 18, 1907, *Coker 193 p.p.*

The costa is of a lighter color than the remaining thallus and is composed of more vacuolate and vertically more elongate cells, reinforced toward the base by numerous rhizoidal medullary hyphae. In our fluid-preserved material the costa, which vanishes near the apex, is often so conspicuous and sharply defined as almost to suggest an *Alaria*, but in other cases it is indistinct and then the resemblance of the plants to the Californian *U. fasciata* f. *taeniata* Setchell, as exhibited in Phycotheca Boreali-Americana *862*, is marked, though they are less dentate-margined than that. However, very similar plants evidently occur on the Californian coast, as is shown by our copy of P. B.-A. *221b*, issued as *Ulva fasciata*, which is apparently to be identified with forma *costata*. The fertile cells in the Peruvian specimen seem to be confined to a clearly marked longitudinal band or zone 1–3 mm. wide along each margin; at least, there is nothing in our material to indicate that this fertile area ever includes the costa or, in fact, really approaches it. In this apparent limitation of the fertile cells and in the possession of a costa and a thinner foliar lamina the plant seems to offer in some measure a transition to the genus *Letterstedtia*.

It is to be noted that a cross section of the thallus does not show the semicircular arrangement of numerous marginal cells about a minute empty space that J. Agardh conceived to be peculiar to *Ulva fasciata*. The thallus may be composed of two parallel strata to the very margin (FIG. 20); or the marginal cells

of one or both layers may divide in a plane oblique to the general surface, so that the extreme margin may become somewhat irregularly 3–4-stratose (FIG. 22), with the two outer cells projecting a little and the margin itself consequently concave or sulcate; or (FIG. 21) one or both of the inner cells in this 3–4-stratose condition may bulge out in such a way that the outline of the margin in a cross section is subtruncate or rarely rounded-convex. It is to be noted also that Montagne, in a rather detailed description* of Algerian specimens of *Ulva fasciata* (Delile's type of the species was from Alexandria, Egypt) states that the margins of the thallus are thickened—are, in fact, a little more than double the thickness of the central upper part—which is just about the reverse of what obtains in these Peruvian plants. However, these Peruvian specimens seem to depart even more widely from the prevailing conception of *Ulva Lactuca* and we hardly think that the circumstances justify the recognition of a separate specific category for forms that are apparently so closely allied to *U. fasciata*. Bory's *Ulva nematoidea* from Concepcion, Chile, can hardly be said to be costate and the name cannot be accurately applied to Dr. Coker's plant, whether it is considered a form, a variety, or a species. However, Montagne,† who maintained *U. nematoidea* Bory as a species distinct from *U. fasciata* Delile, uniting with it the *U. fasciata* of Bory, gave (in herb. Mus. Paris.) an unpublished varietal name to the narrow, costate, ruffled plant of Peru (San Lorenzo, *Gaudichaud*), but as this varietal or form name would seem rather inept or even misleading, especially when associated with *U. fasciata*, we trust that we are excusable for not taking it up and publishing it for the form described above.

Dr. Coker's plants are simple or once furcate near the base and are attached to segments of a *Corallina* by a subterete or inversely cupulate basal callus about 1 mm. in diameter; the costa is usually 0.5–3 mm. broad; the two layers of the thallus are firmly coherent, differing markedly in this respect from a broad *Ulva* that occurs with it—a form that we have referred to *U. Lactuca rigida*.

Ulva fasciata costata was collected at Callao (in 1839) by the

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* Expl. Sci. de l'Algérie 1: 151–153. 1846.

† Voy. Bonite, Bot. Crypt. 6. 1846.

U. S. Expedition under the command of Lieut. Wilkes, according to a specimen in the Columbia College Herbarium, under the name *Ulva latissima*.

PLATE 1. *Ulva fasciata costata*

Photograph of a complete once-forked plant (*Coker 193 p.p.*—from liquid preservative), natural size.

PLATE 2, FIGURES 10–23. *Ulva fasciata costata*

10. A portion of the ribbon-shaped thallus, with indications of the costa and the fertile marginal bands.
11. Basal part of a plant with indications of the thickened axis, the foliar lobes, and the inversely cupulate basal callus surrounding a *Corallina* segment.
12, 13. Cross sections of the basal callus with *Corallina* in the axis.
14–17. Cross sections, successively higher, of the base of the thallus.
18. Outline of the median portion of a cross section of the main thallus, showing costa of about twice the thickness of remaining lamina.
19. Cross section of the costa, showing vertically elongate vacuolate cells.
20. Cross section of the fertile border, showing character of the sporangia, marginal cells, etc.
21. Cross section of margin of thallus where the orientation of the cells makes the extreme margin almost 3-stratose. All of the cells here except the extreme marginal pair become sporangia.
22. A marginal cross section where the orientation of the cells makes the extreme margin almost 4-stratose.
23. A cross section through the lamina at the juncture of the sterile area and the fertile border.

All of the figures are drawn from the type material (Chincha Islands, *Coker 193 p.p.*). Figure 10 is of the natural size; 11–17 are enlarged 9 diameters; 18, 16 diameters; 19–23, 330 diameters.

Ulva simplicissima Clem. was attributed to Callao by Humboldt, Bonpland, and Kunth (Nov. Gen. et Sp. Pl. **7**: 418. 1825). We have not seen their specimens and do not know to what they applied this name, which is currently cited in the synonymy of *Scytosiphon lomentarius*. Possibly an *Enteromorpha* was intended.

Ulva planca Suhr (Flora **23**: 277. 1840), described from Peru, has apparently been overlooked or ignored by subsequent writers. We have not seen it and do not recognize it from Suhr's description, but it seems safe to express the opinion that it is not an *Ulva* in any modern sense.

ENTEROMORPHA Link, Hor. Phys. Berol. 5. 1820

ENTEROMORPHA BULBOSA (Suhr) Mont. Voy. Bonite, Bot. Crypt. 3. 1846. J. Ag. Till Alg. Syst. 3: 139. 1882

Solenia bulbosa Suhr, Flora **22**: 72. *pl. 4. f. 46.* 1839.

Isla Asia, August 26, 1907, *Coker 241 p.p.*; from rocks in the surf, Mollendo, August 1908, *Coker 565 p.p.*

No. 241 p.p., we infer from Suhr's description and figures, is close to the type, which was attributed to Peru without definite locality. The plants are dark green, 3–9 cm. high, stipitate and copiously or very sparingly branched near the base, the frond or its branches becoming 0.5–7.0 mm. broad above; the cells are large, 13–30 μ in diameter in surface view, 28–40 μ deep, mostly rectangular and in rather distinct rows below, becoming more rounded and irregular above, the walls thin, firm, and sharply defined.

No. 565 p.p. is a lighter bluish green, 2–4 cm. high, with the frond or its branches rarely reaching a width of 1 mm., but in the rather bulbous stipitate base, in mode of branching, and in form, size, and arrangement of the cells is much like no. 241, though the chromatophore appears thinner, occupies relatively less of the cell, and often has a stellately lobed margin, while that of no. 241 is usually subentire with a rounded or quadrate outline.

J. Agardh (loc. cit.) in discussing the relationship of *Enteromorpha bulbosa* to *E. compressa* emphasizes the more sordid green color of *E. bulbosa* as a distinguishing characteristic. This might apply to Dr. Coker's 241, but not to his 565, if we are correct in identifying that with *E. bulbosa*. A better distinguishing character, if one may judge from the specimens cited above, is to be found in the much larger and more regularly arranged cells of the Peruvian plant, the cells perhaps averaging to have about twice the diameter of those of *E. compressa*.

ENTEROMORPHA PROLIFERA (O. F. Müll.) J. Ag. Till Alg. Syst. 3: 129. *pl. 4. f. 103, 104.* 1882

Ulva prolifera O. F. Müll. Fl. Dan. 5^{13}: 7. *pl. 763. f. 1.* 1778.

Lobos de Afuera, Mar. 27, 1907, *Coker 145c*—"taken from the bottom of our boat after voyage of one month from Callao."

Sparingly proliferous near the base. Dr. Coker's 145c differs from the specimens that we have referred to *E. bulbosa* in the much smaller cells, which are only about 5–15 μ in diameter, in the thinner membrane, which is mostly 12–20 μ thick, in the slender, reduced, more irregularly disposed branches, in the less sharply

defined cell walls, the more complete filling of the cell by the chloroplast, etc.

(?) ENTEROMORPHA INTESTINALIS (L.) Grev. Alg. Brit. lxvi, 179. 1830. J. Ag. loc. cit. 131

From drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*

The plants are 4–5 cm. long and wholly unbranched, from a very long, slender, terete stipe, the thallus becoming flattened and 1–6 mm. wide above. The narrower plants approach f. *cylindracea* in general outline. The cells average about 13 μ in diameter, though they occasionally show a maximum diameter of 25–27 μ; the membrane is about 20 μ thick. The plants differ from ordinary conditions of *E. intestinalis* in their darker green color and in the rather more regular arrangement of the cells. They differ from *E. bulbosa* in the long-attenuate unbranched stipe, the smaller cells, the thinner membrane, and the much less distinctly defined cell walls.

Enteromorpha intestinalis has been reported from Callao by Montagne (Fl. Boliv. 5. 1839).

ENTEROMORPHA LINZA (L.) J. Ag. Till Alg. Syst. 3: 134. 1882

Ulva Linza L. Sp. Pl. 1163. 1753.

Dredged in Ancón Bay, in 9 fathoms, on a muddy bottom, Feb. 13, 1907, *Coker 90 p.p.* A fragment only, about 32 cm. long and 5–7 mm. wide, margins undulate-plicate or slightly crisped, membrane (double) about 28–33 μ thick,—agreeing essentially with J. Agardh's forma *lanceolata*. This species has been reported from the same general region (Island of San Lorenzo) by Piccone (Alg. Vettor Pisani 23. 1886).

Enteromorpha compressa (L.) Grev. has been reported from Paita by Montagne (Voy. Bonite, Bot. Crypt. 3. 1846) and by Piccone [Mem. R. Accad. Lincei IVa. **6**: —(10). 1889].

Family CHAETOPHORACEAE

GOMONTIA Born. & Flah. Jour. de Bot. **2**: 163, 164. 1888; Bull. Soc. Bot. France **36**: clviii. 1889

GOMONTIA ARHIZA Hariot, Bull. Soc. Bot. France **38**: 417. 1891

In a piece of a shell, with *Hyella caespitosa* Born. & Flah., etc., Isla Vieja, Bahía de la Independencia, in 1 fathom, July 20, *Coker 09639 p.p.*

Few sporangia have been seen but none of them appears to have any such diverticula and rhizoids as have the sporangia of *G. polyrhiza*. The sporangia are also smaller than those of *G. polyrhiza*, rarely exceeding 50 μ in longest diameter. *Gomontia arhiza* was described by Hariot from Tierra del Fuego. *G. polyrhiza* has been ascribed to the American North Pacific by Saunders (Proc. Washington Acad. Sci. **3**: 415. 1901) and by Setchell and Gardner (Univ. California Publ. Bot. **1**: 229. 1903).

ENDODERMA Lagerh. Öfvers. Kongl. Vet.-Akad. Förh. 40^2: 75. 1883

Entocladia Reinke, Bot. Zeit. **37**: 476. 1879. Not *Endocladia* J. Ag. Linnaea **15**: 449. 1841.

Entoderma Wille, in Engler & Prantl, Nat. Pflanzenfam. 1^2: 94. 1890; Loc. cit. Nachträge 83. 1909.

Endoderma strangulans sp. nov.

Endophytic in cell walls, at first filamentous with irregular mostly monopodial branching, forming finally a compact pseudoparenchymatous thallus of indefinite extent and often wholly encircling the host plant, this disc occasionally 2 or 3 cells thick either falsely by the presence of subjacent filaments or actually by cell divisions in the tangential plane, filaments of the disc margin free, interwoven, or more or less anastomosing; cells 6–18 μ wide (averaging 10 μ), mostly irregularly subquadrate or trapeziform, occasionally triangular, those of young filaments often 2–6 times longer than broad, the apical frequently curved, those of the more compact parts of the disc often elongate vertically (radially in relation to the host), obovoid, subpyriform, clavate, fusiform, or conic-cylindric, sometimes 24 μ high; pyrenoids 1–4 (usually 1); most of the cells of the disc at length becoming sporangia with little change in size or form, though commonly developing a short conical beak-like apex; spores 8–64 (?) to a sporangium. [PLATE 3, FIGURES 1–10.]

In the walls of *Chaetomorpha cartilaginea* (type) and *Cladophora* sp.—dredged "in 2½ fathoms," Island of San Lorenzo, Feb. 5, 1907, *Coker 59 p.p.*

This species is evidently closely related to *Endoderma leptochaete* Huber (Ann. Sci. Nat. Bot. VII. **16**: 319. *pl.* *15*. *f.* *1–9*. 1892), described from plants endophytic in European specimens of *Chaetomorpha*, *Cladophora*, and *Ceramium*. It appears to differ chiefly in the greater development of the pseudoparenchymatous disc and in the absence of cilia, the presence of which in the European plant has been considered by Wille [Engler & Prantl, Nat. Pflanzenfam. 1^2: Nachträge 79. 1909] of sufficient importance to justify raising Huber's section *Ectochaete* to generic rank. Dr. Coker's material is preserved with formalin and is apparently in excellent condition but we have been unable to demonstrate the existence of cilia in the plant described above, though we have devoted much time to searching for them, with the assistance of lenses magnifying 1350 diameters or more. There are, however, numerous casually attached filaments of various bacteria and algae that bear more or less resemblance to cilia at first sight. If true cilia occur in these Peruvian specimens, they are, at least, exceedingly rare, and if the species here proposed is ever considered to be synonymous with *Ectochaete leptochaete* (Huber) Wille, the genus *Ectochaete* would seem to rest upon a rather unnatural and unsatisfactory basis.

Endoderma strangulans cannot well be identified with *E. viride* (Reinke) Lag., originally described as an endophyte of *Derbesia Lamourouxii* from the Bay of Naples. *E. viride*, as it occurs in *Derbesia Lamourouxii* at least, does not form a parenchymatous disc in any such sense as does *E. strangulans;* even in the most compact parts the individual filaments are distinctly recognizable, while in the disc of *E. strangulans* cell division takes place in two and sometimes three planes, and all trace of filaments is finally lost; its cells average about 7 μ wide while those of *E. strangulans* average 10 μ and most of its cells are relatively more elongate; the cells of *E. viride* appear to have but a single pyrenoid, while those of *E. strangulans* often have two or more. In *Endoderma viride* f. *Nitophylli* Cotton, originally described from England but occurring also in "*Delesseria phylloloma* Mont." at Callao, the cells average somewhat narrower than in the type in *Derbesia* and are scarcely more than half the average diameter of the cells of *E. strangulans*.

The endophyte of the *Cladophora*, which occurs in smaller quantity under the same collection number as the *Chaetomorpha*, is certainly the same as that of the *Chaetomorpha*, though its cells may average a little narrower. In the *Cladophora* the parenchymatous mass often surrounds the host continuously for a length of several cells; in the *Chaetomorpha* it less commonly wholly encircles the host; in both of the hosts the cell membranes are remarkably thick, whether the endophyte is present or not. By the time that the zoospores (?) are set free, the overlying cuticle and gelatin of the host have often disintegrated and deliquesced to such an extent that no special beak or tube seems to be necessary to permit the zoospores to escape and none is developed, yet in other cases a pronounced apical prolongation of the sporangium is present.

PLATE 3, FIGURES 1–10. *Endoderma strangulans*

1. The endophyte in the walls of *Chaetomorpha*, surface view.
2. A cross section through wall of the *Chaetomorpha*, showing protoplasts of the endophyte; the oval cavity opening to the surface indicates the position of an emptied sporangium.
3. A young plant, in *Cladophora*.
4. A portion of a larger thallus in *Chaetomorpha*, showing more or less complete anastomoses of branches, etc.
5. Older filaments, in *Chaetomorpha*, showing beginnings of pseudoparenchyma.
6. In *Cladophora*, showing pseudoparenchyma of the *Endoderma* in partial optical section.
7. An irregularly subfusiform cell from pseudoparenchyma in wall of *Cladophora*.
8. Apical cells of a free filament in *Chaetomorpha*.
9. Portion of pseudoparenchymatous thallus in wall of *Cladophora*, showing sporangia, etc.
10. Spores penetrating wall of *Cladophora*.

Figure 1 is enlarged 53 diameters; 3–5, 276 diameters; 2, 312 diameters; 6–10, 540 diameters.

ENDODERMA VIRIDE NITOPHYLLI Cotton, Jour. Linn. Soc. 37: 290–295. *pl. 12. f. 1–4.* 1906

Not collected by Dr. Coker, but it occurs in the type specimens of "*Delesseria phylloloma* Mont.," collected at Callao by du Petit-Thouars and preserved in the herbarium of the Muséum d'Histoire Naturelle of Paris, and, less copiously, in the type specimen of "*Delesseria peruviana* Mont.," brought from Callao by d'Orbigny and preserved in the same herbarium in Paris. Both of these

Delesserias belong to *Nitophyllum*, as was soon recognized by Montagne himself, and it is possible that they represent different conditions of a single species. They will be discussed later on in the present paper. In "*Delesseria phylloloma*," the endophyte is so abundant that the lower and older parts of the thallus have a greenish hue caused by its presence. Mr. Cotton's forma *Nitophylli* was described as occurring in various British species of *Nitophyllum*, the figured type being in *N. Hilliae*.

Family CHROOLEPIDACEAE

TRENTEPOHLIA Mart. Fl. Crypt. Erlang. 351. 1817*

Amphiconium Nees, Syst. Pilz. 69. 1817.

Chroolepus Ag. Syst. Alg. xxi, 34. 1824.

TRENTEPOHLIA FLAVA (Hook. & Arn.) De-Toni & Levi, Alg. Zanard. 134. 1888. Var.?

Mycinema ? flava Hook. & Arn. Bot. Beech. Voy. 54. 1832.†

Trentepohlia polycarpa Nees & Mont. Ann. Sci. Nat. Bot. II. 5: 71. 1836; Hariot, Jour. de Bot. 3: 370–374. 1889.

"On rocks at top of cliff on the ocean side of Isla Vieja, Bahía de la Independencia," July 21, 1907, *Coker 225*. "Cliff probably 300 feet high. As the wind, blowing from the ocean, swept up this cliff a very light cloud was continually formed, which dissipated at once as it blew over the top. The rocks were thus kept sufficiently moist for the growth of the alga." Though hardly to be considered a marine plant, this alga was included with the others sent by Dr. Coker and is here commented upon with the others.

The plant differs in several respects from the wood-inhabiting *T. polycarpa* from the island of Juan Fernandez, as originally described by Nees and Montagne, yet would doubtless fall within the limits of Hariot's broad conception of this species. It differs from the original description of *T. polycarpa* in the cell walls

* The older *Trentepohlia* Roth (Usteri, Neue Ann. Bot. 4: 52. 1794) is an apparently harmless homonym.

† This work was issued in parts and 1841, the date of the title page and the date cited by Hariot in his discussion of the synonymy of *Trentepohlia polycarpa*, is the actual date of publication of only the last 53 pages of Hooker & Arnott's work. Part II, comprising pages 49–96, is reviewed by Wikström in his Jahresbericht for the year 1832 (p. 38) and this date is assigned to it by B. Daydon Jackson also (Jour. Bot. 31: 298. 1893).

being, as a rule, externally very smooth, in the septa being thick and distinct, in the absence of sporangia, and presumably also in being coarser and less branched. In respect to the form of the cells and the thickness of the septa and the outer walls, Dr. Coker's plants suggest Hariot's figure (from authentic Chilean material) of the earlier-published *Mycinema ? flava* Hook. & Arn., though the cells are ordinarily smooth. The filaments are very sparingly branched and are mostly 18–36 μ (occasionally as much as 44 μ) in diameter; the cells are 1–2 (rarely 3) times as long as broad, the septa 4–18 μ thick, the outer walls 4–10 μ thick. Reproduction, in our material, appears to occur only by akinetes and aplanospores. Usually, in reproducing, the cells of a filament, or of certain parts of it, round off and separate, often showing a single transverse division before actually being freed from the filament sheath. These cysts then commonly appear to undergo division in two or three planes before new filaments are formed. It rarely happens, also, that certain cells of a filament divide endogenously, giving rise to several ovoid aplanospores, similar to those figured by Meyer for *T. umbrina* (Bot. Zeit. **67**^{1}: *pl. 2. f. 44–47.* 1909), though sometimes more numerous.

Chroolepus peruvianus Kütz. (Phyc. Gen. 284. 1843) was described from "Felsen des peruanischen Hochlandes, mit Rocella." Its occurrence with *Rocella* probably indicates that it was found not far from the coast. It is described as obsoletely articulate, so it cannot agree very well with Dr. Coker's specimen that we have discussed above. Kützing later referred the plant to *Chroolepus flavum* γ *sterile* (Sp. Alg. 428. 1849) and De-Toni (Syll. Alg. **1**: 240. 1889) cites it under *Trentepohlia villosa* f. *rigidula* (Kütz.) De-Toni.

Bulbotrichia peruana Kütz. (Sp. Alg. 429. 1849; Tab. Phyc. 4: 22. *pl. 97. f. III.* 1854), "Peru, ad rupes," "Auf Kalkfelsen in Peru," appears to be an organism of doubtful affinities, though probably of the *Trentepohlia* alliance.

Family CLADOPHORACEAE

CLADOPHOROPSIS Börg. Overs. Kgl. Danske Videnskab. Selsk. Forh. **1905**^{3}: 288. 1905

Cladophoropsis peruviana sp. nov.

Forming extended and rather rigid mats 2–3 cm. deep; rhizoids rare; filaments 1–3 cm. long, commonly unbranched for several cells at the base, then with several clavate mostly one-celled branches, then two or three times subdichotomous (rarely trichotomous) near the middle, the main branches subsimple or finally with clavate, mostly one-celled, often secund, suberect, patent, or divaricate ramuli, the older branches very commonly septate at the base; cells 40–200 μ (mostly 80–175 μ) in diameter, usually 6–22 times longer than broad, rather easily separating at the septa and occasionally regenerating; cells of the ramuli and of the main axes usually of about the same diameter; cell walls in older parts 5–15 μ thick. [PLATE 2, FIGURES 1–9.]

From an estero near La Palisada (between Tumbes and Capón), forming a mat on the mud between the tide-lines, *Coker 370 p.p.* The field notes of the collector describe the color of the plant as "green," but the specimens as they come to us are mostly brown. The color, the frequent separation of the segments at the septa, and the occasional regeneration probably indicate that some of the surrounding conditions, possibly a temporary lack of salinity of the water, were not especially favorable. In Dr. Coker's notes is the following remark:

"A most striking feature of the aestuary region of Tumbes and Capón was the almost entire absence of seaweeds or aquatic grasses. During the greater part of the year there is almost pure seawater in all the aestuaries except at the mouth of the Tumbes River. After the winter rains, which are expected in February, March, or April, the aestuaries are doubtless flooded for a time with fresh water. Oysters, clams, and crabs, however, abound."

The date for this collection is lacking, but another collection in the same vicinity is dated Feb. 2, 1908.

The existence of complete septa at the bases of the older branches in many cases would seem to make it a little doubtful whether this plant should be referred to *Cladophoropsis* or possibly to *Aegagropila*, yet it appears to be most at home with the species for which Börgesen has proposed the generic name *Cladophoropsis*.* Some of the septa which seem at first sight to be complete are found upon careful examination to be perforate.

* Reinbold (Siboga-Exped. Monog. 69a: 78. 1913) has recently discussed irregularities in the position of the septa in a plant that he has provisionally named "*Cladophoropsis paradoxa* (?)."

From *Cladophoropsis membranacea* (Ag.) Börg., the Peruvian plant differs obviously in the more rigid and more slender filaments and in the more frequent basal septa. Its nearest affinities are probably to be found in the originally New Zealand **Cladophoropsis herpestica** (Mont.),* and the closely allied originally Javan *Cladophoropsis Zollingeri* (Kütz.) Börg. But the Peruvian specimens are more slender and lack the peculiar ramuli "decussato-adnati" described by Montagne for *Conferva herpestica* and figured by Kützing for his *Aegagropila Zollingeri* (Tab. Phyc. 4: *pl. 64. f. II*). The connections of these ramuli are imperfectly represented by Kützing, for in the authentic material in the Kützing herbarium (which we have seen through the kindness of Mme. A. Weber-van Bosse), as well as in the type specimen of *Conferva herpestica*, the lateral branch crowds aside the main axis and makes it falsely lateral and the "adnate" character is further brought about by the development of a rhizoid or a rhizoidal branch above the septum at the base of what was originally a segment of the main axis. The strong transverse septum drawn by Kützing for his *A. Zollingeri* at two points of "adnation" should be deleted or rather should be made to lie vertically or obliquely between the main filament and the "adnate" or falsely lateral branch (which is really a direct continuation of the main filament). The filaments of *Conferva herpestica* were described by Montagne as 300 μ in diameter and its walls as 30 μ and more thick; in the type of this species, now preserved in the Muséum d'Histoire Naturelle, which we have been permitted to examine through the courtesy of Professor Mangin and M. Hariot, the average diameter of the filaments seems to be considerably above 300 μ, individual filaments often attaining a diameter of 500 μ, although rhizoidal branches are often less than 200 μ in diameter; the cell walls in the type are mostly from 20 to 50 μ thick.

The filaments of Kützing's *Aegagropila Zollingeri*, if one should judge from his natural-size figures, sometimes attain a diameter of more than 500 μ, though in his enlarged figure, according to the scale given, they are but 150–250 μ, which corresponds approximately with the measurements given by him in his "Species Alga-

* Comb. nov. (*Conferva herpestica* Mont. Prod. Phyc. Antarct. 15. 1842; Voy. au Pole Sud, Bot. 1: 6. 1845.)

rum" (p. 415). In the authentic material that we have examined, collected in Java by Zollinger, the filaments are mostly 215–315 μ in diameter. The cell walls are very much thinner than in *Cladophoropsis herpestica*, being only 5–11 μ thick. This character and the shorter, more slender filaments should probably be deemed sufficient, for the present, to justify considering *C. Zollingeri* distinct from *C. herpestica*.

PLATE 2, FIGURES 1–9. *Cladophoropsis peruviana*

1. Apical portion of a filament. Two of the three branches have septa at the base, while the third, the lowest of the three, has none.
2. A portion of a filament showing two nearly opposite branches of which one has a basal septum and the other has none.
3. The base of a filament.
4. Apex of a filament showing a short apical cell and a branch with lumen continuous with that of the main filament.
5. Apical portion of a filament with four secund lateral branches, of which the lowest has an incomplete septum at the base and the remaining three have a continuous lumen.
6. Portion of a filament with subdichotomous branching and branches all septate at base.
7. A lateral branch with a septum just beyond the point of emergence from the main filament.
8. Apex of main filament, showing a short subcapitate apical cell.
9. Regeneration of a broken filament.

All of the figures are drawn from the type material (La Palisada, between Tumbes and Capón, *Coker 370 p.p.*). Figures 1 and 3 are enlarged 9 diameters; 2, 4–7, 13 diameters; 8 and 9, 40 diameters.

CLADOPHORA Kütz. Linnaea 17: 91. 1843

Cladophora Hariotiana sp. nov.

Soft, gelatinous, dark- or yellowish-green, slightly nitent, forming dense tufts 8–30 cm. long; main filaments 150–340 μ in diameter, somewhat flexuous, virgately branched with percurrent monopodial axes, the branches mostly 3–6 cells apart, flexuous, erecto-patent, distinctly lateral or arising by a false di–trichotomy, the two or three branches in the latter case of very unequal length, the longer branches once or twice compounded like the main filaments; ultimate lateral branchlets 35–55 μ in diameter, about one half the diameter of the filaments from which they spring, gradually tapering to a blunt point, suberect or erecto-patent, often slightly incurved, the lower 6–8 cells long, the upper mostly 2–4 cells long, usually secund and arising from nearly every cell of the rachis, this excurrent for 3–5 cells; cells of the main filaments mostly 3–10 times longer than broad, cylindric or slightly

enlarged near the middle or towards the distal end, those of the ultimate branchlets 2–6 times longer than broad, constrictions at the septa often more or less obvious in dried material, scarcely so in the fresh; cell walls thin, mostly 2–10 μ thick; chloroplasts reticulately disposed, filling the cell rather uniformly. [PLATE 4.]

In a lagoon at La Puntilla, Bay of Paracas, region of Pisco, June 29, 1907, *Coker 09619 p.p.* "This 'lagoon' is a small shallow arm of the bay."

In general habit as well as in the form of the cells, *Cladophora Hariotiana* perhaps suggests *C. gracilis* as much as any other commonly recognized species of the genus, but the branching of the Peruvian plant is more virgate, the main filaments are less angularly flexuous, the cells of the principal axes have twice the diameter of the corresponding cells of *C. gracilis*, and the plant is more gelatinous and adheres more firmly to paper.

It was our first impression that this *Cladophora* of the Bay of Paracas might prove to be a condition of *C. allantoides* (Mont.) Kütz., the type of which came from brackish water near Callao, which is about 220 kilometers farther north. Kützing's figures (Tab. Phyc. 4: *pl. 42. f. I*) of this species, drawn from authentic material, were rather suggestive of Dr. Coker's plant, though in this comparison it was noted that the cells as there represented were hardly long enough, on the average, in proportion to their width, that the cells that gave off branches had too much of a shoulder below the branch, and that the ultimate branchlets were too many cells long to agree with the Paracas plant. An examination of the original material of *Cladophora allantoides* showed other differences so pronounced as to make the identification of Dr. Coker's plant with it out of the question. The main filaments of *C. allantoides* range from 90 to 160 μ in diameter, while those of *C. Hariotiana* range from 150 to 340 μ; its ultimate branchlets are less numerous and are often 15–30 cells long instead of 2–8 cells long; its cells often collapse in drying and the constrictions at the septa are more pronounced, both of which characters evidently suggested to Montagne the specific name *allantoides;* the chloroplasts have a tendency to mass near the septa ("nigroque punctatis"), leaving the middle portion of the cells more or less hyaline, while in *C. Hariotiana* the chloroplasts are rather uniformly distributed and in drying often recede a little from the ends of the

cells, leaving narrow hyaline zones at the septa; *C. allantoides* is of much firmer consistency than *C. Hariotiana* and adheres rather imperfectly to paper on drying, while *C. Hariotiana* adheres to paper very much like some of the more delicate and gelatinous species of *Callithamnion*.

It is a pleasure to associate with this attractive species the name of M. Paul Hariot, assistant in the Muséum d'Histoire Naturelle of Paris, to whom the writer is greatly indebted for the privilege of seeing not only the type specimens of *Cladophora allantoides* but also the original materials of many other South American species, an examination of which was necessary to any adequate understanding of Dr. Coker's Peruvian collections.

PLATE 4. *Cladophora Hariotiana*

Photograph of the dried type specimen, natural size.

CLADOPHORA FASCICULARIS (Mert.) Kütz. Phyc. Gen. 268. 1843; Tab. Phyc. 3: *pl. 90. f. II.* 1853

Conferva fascicularis Mert.; Ag. Syst. Alg. 114. 1824. Mont. Fl. Boliv. 4. *pl. 7. f. 1.* 1839.

In beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 38 p.p.*; dredged in "about 2½ fathoms" near northeast side of San Lorenzo Island, region of Callao, Feb. 7, 1907, *Coker 59 p.p.*; growing on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 196 p.p.*; from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*

The numbers cited include a considerable range of forms and may or may not represent a single species. Some of them are evidently what Montagne described and figured as *Conferva fascicularis*, but there is some doubt as to whether any of the Peruvian material should be identified with this typically West Indian species. Two fragments, one under no. 38 and the other under no. 59, both from the Callao region, whence came the plant figured by Montagne, make an approach to *Cladophora fascicularis* in mode of branching and in form and size of cells, but the cells are apparently more rigid and thicker-walled, the walls becoming laminated in the older parts, and the constrictions at the septa are less pronounced. In the other specimens cited, these aberrant

characters are even more emphasized and, in addition, the mode of branching departs widely from the typical *C. fascicularis.* In nearly all the material collected under no. 38—the only one of the numbers cited in which the material is ample—the plants are very sparingly branched and hardly suggest *C. fascicularis*, yet this, though rather coarser and thicker-walled, is apparently the same as the plant (also from Callao) that Montagne described as *Conferva fascicularis β laxissima;* it is probably, also, the same as the plant from Callao that is listed by Piccone (Alg. Vettor Pisani 27. 1886) as *Cladophora nuda* Harv., to Kützing's figure of which (Tab. Phyc. **4**: *pl. 2. f. II.*), with its thick laminated cell walls, it bears a considerable resemblance, but it is apparently twice as coarse as *C. nuda*, the main filaments having a diameter of 230–340 μ and the ramuli 120–137 μ. Dr. Coker's nos. 196 p.p. and 465 p.p., from farther south, are fragmentary, are somewhat intermediate in coarseness and in mode of branching between the two extremes that we have described, and, as they come to us, are characterized by an intensely dark green endochrome. Being in doubt as to the relationships and the range of variation of the specimens here grouped together, we have preferred, for the present, to leave them where Montagne placed similar plants from the same region.

CLADOPHORA ALLANTOIDES* (Mont.) Kütz. Sp. Alg. 408. 1849; Tab. Phyc. **4**: *pl. 42. f. I.* 1854

Conferva allantoides Mont. Ann. Sci. Nat. Bot. II. **8**: 349. 1837; Fl. Boliv. 3. 1839.

In brackish water (with *Enteromorpha*) in the Lima River near Callao, *d'Orbigny.* It was apparently not collected by Dr. Coker. De-Toni (Syll. Alg. **1**: 292. 1889) has reduced Montagne's species to the rank of a variety of *C. crispata* (Roth) Kütz., with which, in our opinion, it probably does not belong. Remarks on some of its characteristics have been made above in the discussion of *Cladophora Hariotiana.*

* This name was originally published with the *-es* ending and was again printed that way by Montagne two years later. In the Montagne herbarium, however, both the *-es* and the *-ea* endings are found, and the name was printed with the *-ea* ending by Kützing in 1849.

CHAETOMORPHA Kütz. Phyc. Germ. 203. 1845

Aplonema Hass. Brit. Freshw. Alg. 213. 1845.

Chaetomorpha cartilaginea sp. nov.

Filaments erect, often twisted by wave action, rather rigid and cartilaginous-corneous throughout, attaining a height of 16 cm., affixed by branching rhizoids and more or less rhizomatous at base, mostly 250–400 μ in diameter, though only 150–170 μ in lower part of basal cell, not constricted at septa; cells cylindric, usually 2–7 times longer than broad; the basal cell 2–4.5 mm. long, 10–20 times as long as its average diameter; cell walls conspicuously lamellate or delaminating internally except in youngest parts, becoming 25–110 μ thick. [PLATE 3, FIGURES 11–13; PLATE 5.]

Growing on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 196 p.p.*—type. Also, what is probably a form of the same thing, but with short cells, mostly ⅔–1½ times as long as broad, and without basal parts, in beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 38 p.p.* Near San Lorenzo Island, not far from La Punta, old and battered specimens were dredged in 2½ fathoms (*Coker 59 p.p.*) with cells of a character about intermediate between those of no. 38 and those of the type; these dredged specimens are without basal parts and in two cases cells were observed that were beginning to put forth diverticula somewhat after the fashion of *Rhizoclonium*, but it is probable that these were simply efforts of old detached filaments of a *Chaetomorpha* to regenerate or attach themselves. The remarkably thick laminated walls and the cylindrical unconstricted segments are common to all three collections.

The type form of *Chaetomorpha cartilaginea* bears a slight resemblance to the more rigid conditions of *Chaetomorpha aerea* (Dillw.) Kütz., which is sometimes considered an attached form or variety of the earlier-published *Chaetomorpha Linum* (O. F. Müll.) Kütz.; but *C. cartilaginea* is attached by widely spreading and branching hapteres, while *C. aerea* has a discoid or scutate base; the basal cell of *C. cartilaginea* is 10–20 times as long as broad, while in *C. aerea* it is 2–10 times as long as broad; the cells in the attached type specimen of *C. cartilaginea* average to be much longer than in *C. aerea*, though this is not the case in one

of the unattached specimens that we are somewhat doubtfully identifying with *C. cartilaginea;* the thickness of the cell wall in *Chaetomorpha* evidently varies with the age and state of preservation of the specimen, but we never have seen the walls so uniformly and strongly thickened in any specimens identified with *C. aerea* or *C. Linum*.

Chaetomorpha cartilaginea doubtless finds its closest relative in *C. antennina* (Bory) Kütz., of which *C. pacifica* Kütz. is probably a synonym. With *C. antennina*, *C. cartilaginea* agrees in the nature of its holdfast and in the character of the basal cell it is perhaps nearer to that than to the *C. aerea* group. But the basal cell of the genuine *C. antennina** is much longer and more highly

* The type of *Conferva antennina* Bory (Voyage dans les quatre principales îles des mers d'Afrique 2: 161. 1804) from Ile Réunion (Bourbon) is preserved in the herbarium of the Muséum d'Histoire Naturelle at Paris and we have been allowed the privilege of examining it through the courtesy of Professor Mangin and Monsieur Hariot. Its filaments are 4–9 cm. long, flaccid above the rigid one-celled base, much crumpled, collapsed, and contorted towards the apices; the basal cell is commonly 10 mm. and often more than 15 mm. long, 20–40 times longer than its average diameter, increasing in diameter from about 150–200 μ at base to 500–580 μ above, though the filament above the basal cell is more slender, being mostly 270–400 μ in diameter; cells above mostly ⅔–1½ times as long as broad, with constrictions at most of the septa; cell walls, exclusive of basal parts, usually 6–16 μ thick. Most, at least, of the so-called *Chaetomorpha antennina* from the West Indies has a much shorter basal cell than the Réunion type, the cells in the upper part of the filament are relatively longer, and the diameter of the filament above is commonly greater; it should probably be known as *Chaetomorpha media* (Ag.) Kütz.

Chaetomorpha pacifica Kütz. (Sp. Alg. 379. 1849) was established on a specimen from Java collected by Zollinger and one from St. Augustin, Mexico, collected by Liebmann. Of these, the specific name might indicate that the St. Augustin plant should be preferred in selecting the technical type, though when Kützing came to figure the species the Javan plant was apparently chosen for the purpose. We have seen the St. Augustin specimen through the kindness of Mme. Weber-van Bosse and think it would be impractical to try to distinguish it specifically from *C. antennina*, even though there are certain differences, the principal being that the cell walls are often thicker and delaminating with age, even though the cells of the filament in the dried condition are crumpled, collapsed, and contorted almost to the basal cell; the filaments are also stouter above than in the type of *C. antennina*, having mostly a diameter of 500–630 μ.

Chaetomorpha pacifica (H. L. Lyon) Wille [in Engler & Prantl, Nat. Pflanzenfam. 1²: Nachträge 118. 1910—*Chaetomorphopsis pacifica* H. L. Lyon, in Tilden, Am. Alg. no. 458. 1901] from Hawaii, seems, by a happy chance, to be not very different from the earlier-published *Chaetomorpha pacifica* Kütz., though the basal cell is less elongate and specialized, being mostly 4–10 mm. long. The filaments are described as having a diameter of 500–800 μ; in the single rather small specimen that we have

specialized, being 10–15 mm. long (or even 24 mm. long in Kützing's figure of *C. pacifica* [*macropus*], Tab. Phyc. 3: *pl. 60. f. III*) as compared with 2–4.5 mm. long in *C. cartilaginea*, and the filaments of *C. antennina* are rigid in the basal parts only, being flaccid above, with constrictions at most of the septa.

PLATE 3, FIGURES 11–13. *Chaetomorpha cartilaginea*

11 and 12. Basal parts of two filaments.

13. Cells from near the apex of a filament, showing thick laminated walls, etc.

All figures from the type material (*Coker 196 p.p.*). Figure 11 is enlarged 7 diameters; figures 12 and 13, 22 diameters.

PLATE 5. *Chaetomorpha cartilaginea*

Photograph of a dried specimen (*Coker 196 p.p.*), natural size.

Family BRYOPSIDACEAE

BRYOPSIS Lamour. Nouv. Bull. Sci. Soc. Philom. 1: 333. My 1809; Jour. de Bot. 2: 133. 1809

Bryopsis rhizophora sp. nov.

Suberect, densely cespitose, irregularly branched, dark green, dull (not nitent), 3–5 cm. high, from a matted base of branching rhizoids; stipe 1–2 cm. long, mostly 300–650 μ in diameter; main axis percurrent, of about twice the diameter of the principal branches; branches of two or sometimes three orders, opposite, alternate, or irregularly few-ranked, subdistichous, subsecund, or very irregularly grouped; branches of the first order fastigiate, with long naked bases and subplumose or somewhat fasciculate-racemose apices, or sparingly long-branched below, each of the older (up to within 5–10 mm. of apex of main axis) bearing at its base one or two finally much elongate and often furcate decurrent or squarrose-recurved rhizoidal processes, of nearly equal diameter, often giving the branch the appearance of being laterally adnate; lower branches of the second order subfiliform, suberect or patent, often curved, simple or subplumose-ramulose at apex, commonly with a short decurrent rhizoidal process at base; apical ramuli (branches of second or third order) erect or erecto-patent, long-cylindric or subclavate, mostly 0.3–1.5 mm. long, 65–110 μ in diameter, lightly constricted at the base, the axis excurrent; older ultimate ramuli becoming gametangia with little change in form; scars from delapsed gametangia or ramuli wanting or very rare. [PLATE 6, FIGURE A; PLATE 7.]

seen we have observed none more than 650μ in diameter. The Hawaiian plant is certainly more closely allied to *C. pacifica* Kütz. and *C. antennina* (Bory) Kütz. than to Dr. Coker's no. 196, which can not well be identified with *C. antennina*.

"Abundant on rocks," Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 77* (type) and *80 p.p.*

It may seem rash to propose a "new species" in a genus in which diagnostic characters are apparently so unstable and in which synonymy is so involved as in *Bryopsis*, yet we have been unable to find any description or specimen with which we could identify Dr. Coker's Peruvian plant with any degree of satisfaction, even though it offers points of contact with several already recognized species. Possibly it deserves comparison with *Bryopsis corymbosa* J. Ag., described from small plants epiphytic on *Codium* at Livorno (Leghorn), Italy. We have seen no authentic specimens of this, but it is described by Agardh as having the nitid facies of other species of the genus, a pyramidal frond, subsquarrose upper branches, and certain other characters that are not found in the Peruvian plant, and nothing is said of any rhizoidal decurrence of the branches. In color, habit, and lack of lustre, Dr. Coker's specimens are rather strikingly suggestive of *Caulerpa fastigiata* Mont. However, the lack of the characteristic *Bryopsis* lustre may be due in part to the mode of preservation and to a rather liberal and intimate coating of diatoms that is often present.

In general size and habit, the Peruvian specimens resemble the Adriatic plant figured by Kützing (Tab. Phyc. **6**: *pl. 73. f. II*) as *Bryopsis fastigiata*, but have a more pronounced main axis and excurrent rachides, and there is in Kützing's figure and description no indication of decurrent rhizoidal prolongations at the base of the branches. However, authentic specimens from the Kützing herbarium, which we owe to the courtesy of Mme. Weber-von Bosse, show that such prolongations do occur, though in a less pronounced degree than in Dr. Coker's plants, but *B. rhizophora* evidently differs, in addition to the larger more pronounced main axis and excurrent rachides, already mentioned, in the much more rigid, less gelatinous, non-nitent, dark green thallus. De-Toni (Syll. Alg. **1**: 433) makes *B. fastigiata* a synonym of *B. corymbosa* J. Ag., but J. Agardh is inclined to identify it with *Bryopsis plumosa* (Till Alg. Syst. 5: 25. 1887). Rhizoidal outgrowths at the bases of the branches are not unknown in certain other species of *Bryopsis*, but nowhere else in the genus have we found them such

a pronounced and conspicuous feature.* In *B. rhizophora* they are often nearly as large and as long as the branch itself, so that the branch appears laterally attached near its middle. In the Californian *B. corticulans* Setchell (Phyc. Bor.-Am. *626*), a plant very different in size and habit, the corresponding rhizoids are much smaller than the branch and are commonly short and numerous. In a plant from farther north on the Pacific Coast, distributed in the Phycotheca Boreali-Americana (no. 1028) as *Bryopsis hypnoides*, also different from *B. rhizophora* in size, habit, and mode of branching, the corresponding rhizoids are fewer and longer than in *B. corticulans*, but are also much smaller than the branches from which they spring and look like rhizoids rather than like downward continuations of the branches themselves. In the "*Bryopsis Rosae*," from the Falkland Islands, figured by Kützing (Tab. Phyc. **6**: *pl. 84. f. II*), some of the ramuli have decurrent rhizoidal bases, but these ramuli have twice the diameter of those of the Peruvian plant; and whatever the relationship of the Peruvian plant to that figured by Kützing, it is rather manifest that the *Bryopsis Rosae* of Kützing is not the same as the original *Bryopsis Rosae* of Agardh and of Gaudichaud.

In the form and arrangement of the ultimate ramuli, *Bryopsis rhizophora* is rather suggestive of Kützing's figure of *B. adriatica* (Tab. Phyc. **6**: *pl. 79. f. 11b''*), but the form of the whole plant is very different, and Kützing's figure shows conspicuous scars from deciduous gametangia which we have not noted in the Peruvian specimens. This figure of Kützing's is currently cited as belonging to *Bryopsis cupressina* Lamour.,† to the original figure of which the Peruvian plant bears little resemblance.

In addition to its own gametangia, this Peruvian *Bryopsis* exhibits what appear to be the sporangia of an endophyte, probably a Chytridiaceous fungus. The form of these sporangia is outlined in our figures. They are mostly thimble-shaped, hemispheric, or difform, or suggest raspberry fruits (*Idaeobatus* section

* E. S. Barton (Jour. Bot. **33**: 161. *f. 6.* 1895) has described and figured, in the case of South African *B. cupressina*, what she believed to be independent plants attached to larger individuals of the same species and simulating branches.

† This specific name was changed by J. Agardh in 1842, perhaps inadvertently, to *cupressoides*, and later writers appear to have adopted this illegal and unnecessary modification of the original name.

of *Rubus*) by cupping over a core of the protoplasm of their host. They occur at the apices of the ultimate ramuli or of the axes from which these ramuli spring; in the latter case they appear to inhibit the growth of the axis (FIGS. 10 and 11). The sporangium is soon separated from the protoplasm of its host by an irregularly dome-shaped hyaline zone, and eventually this seems to be converted into a solid wall, thus healing the wound to the host. The sporangium as a whole commonly has a greenish hue, but this is apparently due to the chloroplasts of an axial core that belongs to its host.

PLATE 6, FIGURE A. *Bryopsis rhizophora*

Photograph of a dried specimen (*Coker 77*), natural size.

PLATE 7. *Bryopsis rhizophora*

1. A single plant, natural size.
2 and 3. Apical parts of pinnae (branches of the first order).
4. Apical portion of main axis.
5. Base of plant.
6. Branches of the second order, with short rhizoidal processes at base.
7–9. Bases of branches of the first order, 2–3 cm. above the base of the plant, showing elongate rhizoidal processes.
10–13. Branches showing sporangium-like malformations, apparently due to an endophyte, perhaps a Chytridiaceous fungus.

Figures 2–4 are enlarged 28 diameters; 5–9, 13 diameters; 10–13, 32 diameters.

Derbesia Balbisiana (Lamour.) Piccone, *Bryopsis plumosa* (Huds.) Ag., and *B. Leprieurii* Kütz. are attributed to Peru by Piccone,* but we find in Dr. Coker's collections no material that may be referred to any one of these species.

Family CAULERPACEAE

CAULERPA Lamour. Nouv. Bull. Sci. Soc. Philom. **1**: 332. My 1809; Jour. de Bot. **2**: 141. 1809. Weber-van Bosse, Ann. Jard. Bot. Buitenzorg **15**: 259. 1898

Chauvinia Bory, Voy. Coquille, Bot. Crypt. 204. 1828.
Tricladia Dec. Ann. Sci. Nat. Bot. II. **17**: 337. 1842.
Herpochaeta Mont. Ann. Sci. Nat. Bot. II. **20**: 305. 1843.
Stephanocoelium Kütz. Bot. Zeit. **5**: 54. 1847.
Corradoria Trevis. Linnaea **22**: 131. 1849.
Himandactylius Trevis. loc. cit. 134.
Ahnfeldtia Trevis. loc. cit. 140.

* Mem. R. Accad. Lincei IVa, 6: –(13). 1889.

Chemnitzia (Dec.) Mont. Orb. Dict. **10**: 53. 1849.
Phyllerpa Kütz. Sp. Alg. 494. 1849.

CAULERPA FLAGELLIFORMIS LIGULATA (Harv.) Weber-van Bosse, Ann. Jard. Bot. Buitenzorg **15**: 274. *pl. 24. f. 7.* 1898

Islands of Lobos de Afuera, Mar. 17 and 18, 1907, *Coker 124 p.p.* (PLATE 8) and *126*. "Growing abundantly on the rocks in shallow places (d. 6 dm.), forming a thick carpet over the bottom in some places. Bright green, with indistinct striations of darker color." Fragments of this species, together with those of *Rhodymenia flabellifolia* and *Gelidium* sp. were taken from the stomach of a green turtle in the same locality, *Coker 146 p.p.*, Mar. 25, 1907.

PLATE 8. *Caulerpa flagelliformis ligulata*

Photograph of a specimen (*Coker 124*) from liquid preservative, reduced to about two fifths of the natural dimensions.

The plants are remarkably similar to the South African *Caulerpa ligulata* of Harvey and of J. Agardh. The fact that terete branches occur occasionally intermingled with the distinctly flattened ones would appear to be evidence in favor of the correctness of Madame Weber-van Bosse's view in uniting *Caulerpa ligulata* with *C. flagelliformis*. The plants reach a height of 50 cm. and the flattened branches have a width of 2–5 mm. The bases of the fronds are in most cases very distinctly annulate and there are occasionally rather regular constrictions in the upper flattened parts giving the margin here and there a sinuate-crenate character. The lower flattened parts are plainly longitudinally striate and furrowed, the dark striations being due chiefly to an arrangement of the chloroplasts in lengthwise lines or veins. In some of the median and upper parts (the material is preserved with formalin) the chloroplasts are conglobate or aggregated, giving these areas a flecked appearance. We have noticed also, as have Suhr and Madame Weber-van Bosse, decolorate areas which appear to be cut off from the adjacent parts below or above by a ridge or partition. The tips of the branches, also, are very commonly decolorate or yellowish, as is often the case in other species of *Caulerpa*.

This, so far as we are aware, is not only the first record of the

occurrence of the present species in American waters, but is also the first record of the occurrence of a species of *Caulerpa* on the shores of Peru. Montagne, however, lists three widely distributed species of the genus in his flora of Chile (C. Gay, Hist. Fis. y Pol. Chile, Bot. **8**: 374–377. 1854).

Family CODIACEAE

CODIUM Stackh. Ner. Brit. xvi, xxii, xxiv. 1797. De-Toni, Syll. Alg. 1: 488. 1889

Lamarckia Olivi, Zool. Adriat. 258. 1792. Not *Lamarkia* Medic. Vorles. Chur. Phys. Oek. Ges. 4^1: 183. 1789.

Spongodium Lamour. Ann. Mus. Hist. Nat. **20**: 288. 1813.

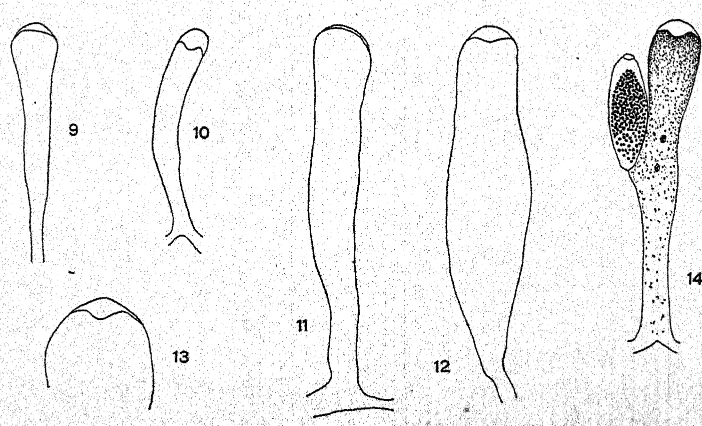
Agardhia Cabrera; Ag. Syn. Alg. Scand. xxiv. 1817.

Acanthocodium Suring. Ann. Mus. Bot. Lugd.-Bat. **3**: 258. 1867.

Codium tomentosum peruvianum var. nov.

More or less complanate, especially under the dichotomies, rather closely and subflabellately dichotomous toward the apices; apical wall of the peripheral utricles often much thickened (3–40 μ thick), with the thickening now and then introrsely umbonate as well as externally convex (up to 70 μ thick, including internal umbo); gametangia (♀ ?) ovoid-fusiform to elongate-clavate, 200–350 μ × 60–110 μ. [PLATE 9; TEXT FIGURES 9–14.]

Lobos de Afuera, March 27, 1907, *Coker 145a;* Bay of Chilca, in 1½ fathoms, September 2, 1907, *Coker 242* (type).



FIGURES 9–14. *Codium tomentosum peruvianum.* 9–12, outlines of peripheral utricles, showing varying amounts of thickening of apical wall; 13, apex of utricle, with introrsely umbonate thickening; 14, gametangium, etc. All of the figures are enlarged 55 diameters.

PLATE 9. *Codium tomentosum peruvianum*

Photograph of a specimen (*Coker 242*), from liquid preservative, natural size.

Our specimens are very dark green and are only 6–10 cm. high, at which size they bear gametangia and are apparently mature. The peripheral utricles are clavate, 500–1000 μ long, 70–240 μ in maximum diameter, 2½–7 times longer than their greatest width, truncate, subtruncate, or rounded at apex, which may be very strongly or not at all thickened, even in closely adjacent utricles; the cuticle is smooth. The gametangia are often paired or occasionally in verticils of three.

These Peruvian plants, as our photograph of a fluid-preserved specimen well shows, differ obviously from the typical English *Codium tomentosum* in the more complanate thallus and the more congested and more flabellate mode of branching. Under the microscope, one is impressed by the usually much thickened apical walls, the more strongly thickened of these often having a pronounced inwardly directed umbo. We have never seen such extreme thickening in any European specimens referred to *C. tomentosum*, though Hohenacker's Meeralgen no. 497 from Cherbourg makes an approach to it in this respect. And the gametangia are rather larger than in the English *C. tomentosum*. In the matter of thickening, the utricles occasionally suggest those of the Australian *C. galeatum*, though scarcely galeate or contracted. The utricles of the Peruvian plant have, however, about half the diameter of those of *C. galeatum* and are, at least relatively, longer. The thickening of the apical wall of the utricles is even more pronounced in *C. galeatum*, and more uniform, often reaching a thickness of 80–95 μ even without an introrse umbo, which is rarely developed. In general habit, the Peruvian plant perhaps resembles the Australian *C. galeatum* slightly less than it does the English *C. tomentosum*.

J. Agardh's description of *Codium lineare* C. Ag. is in some respects suggestive of the plant that we have described above, but this can hardly be said of C. Agardh's original description. The specimen on which *C. lineare* was founded J. Agardh suspects to represent a monstrous form. J. Agardh attributes thin-walled utricles to *C. lineare*, which character does not obtain in the Peruvian plant. J. Agardh also considers the Brazilian *C. decum-*

bens Mart. a synonym of *C. lineare*, but *C. decumbens*, if we are correct in identifying with it Uruguayan specimens agreeing very well with Martius' description, has large thin-walled utricles that are mostly 240–500 μ in maximum diameter.

Codium tomentosum, under the name *Spongodium commune*, was attributed to Paita, Peru, by Bory (Voy. Coquille, Bot. Crypt. 211. 1829).

Codium foveolatum sp. nov.

Thallus deep green, 10 cm. (or more?) long from a repent or decumbent branching base; main axes unbranched for 2–3 cm., then closely subflabellately or subpalmately 2–5 times rather irregularly dichotomous, the segments subterete or slightly flattened, here and there twice as broad as thick, 3–7 mm. broad, obtuse; peripheral utricles mostly free and irregularly subimbricate on drying, giving surface of thallus a rather coarsely vesicular-spongiose appearance, cylindric-clavate to long-obovoid, mostly 800–1150 μ long and 200–500 μ in greatest diameter, commonly slightly enlarged for 200–300 μ below the apex, then often with 2–4 gibbosities and abruptly contracted or sometimes with a second inflation near the base, the walls rather flaccid and easily collapsible, the subtruncate or broadly rounded apex slightly thickened (apical wall usually 6–13 μ thick), the cuticle of the exposed apex minutely foveolate, areolate, papillate, verruculose, or rugulose, the foveolae irregular, mostly 3–7 μ in diameter; gametangia unknown. [PLATE 10; TEXT FIGURES 15–19.]

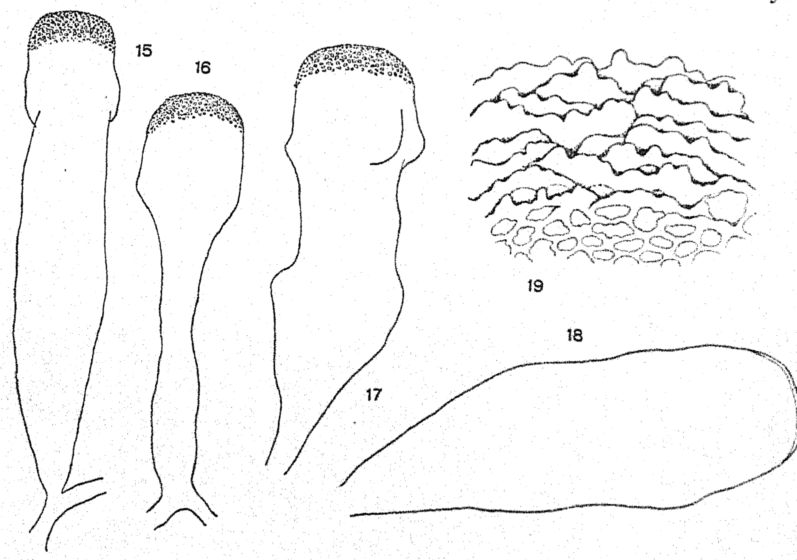
"In the surf," Lobos de Tierra, April 2, 1907, *Coker 150 b.* The specimen is attached to a piece of rock, and is associated with the basal parts of a *Corallina*.

Only one specimen was collected, but the plant has such striking peculiarities that we do not hesitate to suggest that it represents a hitherto unrecognized species, even though a microscopic reëxamination of the types of one or two of the more anciently described species might possibly be desirable in this connection. So far as we are aware, no pitting of the utricle wall has previously been observed in the genus *Codium*. Possibly the Peruvian plant deserves comparison with the Brazilian *C. decumbens* Mart.,* but if we are right in identifying with *C. decumbens* specimens recently collected near Montevideo by Dr. F. Felippone, it has a smooth cuticle like the other previously known species of the genus; the

* Fl. Brasil. (Enum. Pl. Brasil.) 1: 19. 1833.

terminal segments of its thallus are also commonly attenuate.

In general size and habit this species is not very different from our *Codium tomentosum peruvianum*, though *Codium foveolatum* evidently has a more repent or rhizomatous base and is apparently of a lighter green color, but the two are widely different in the character of their utricles, as is manifest even to the naked eye.



FIGURES 15–19. *Codium foveolatum*. 15, a typical peripheral utricle; 16 and 17, other forms of utricles; 18, a utricle in optical section, showing slightly thickened apical wall; a portion of the exposed apical surface of a peripheral utricle, showing pits, ridges, and areolae. Figures 15–18 are enlarged 55 diameters; 19, 390 diameters.

PLATE 10. *Codium foveolatum*

Photograph of the type specimen, from liquid preservative, natural size.

An unnamed *Codium* from Peru is mentioned as the host of *Rhodopeltis Geyleri* Ask. (Bot.-Morph. Studien 42. 1872), an epiphyte that has since been identified with the South African *Placophora Binderi* (see Goebel, Flora 72: 3. 1889).

Halimeda Tuna (Ell. & Soland.) Lamour. has been reported from Paita, Peru, by E. S. Barton,* but we have found no representative of this genus in Dr. Coker's Peruvian material.

* Siboga-Exped. Monog. 60: 13. 1901.

PHAEOPHYCEAE

Family ECTOCARPACEAE

STREBLONEMA Derb. & Sol. in Cast. Suppl. Cat. Pl. Marseille 100. 1851

Streblonema radians sp. nov.

Endophytic and amphigenous, scarcely exserted, forming suborbicular dark green patches mostly 5–20 mm. in diameter, the older becoming lighter-colored in the center as the margins advance; filaments in the medulla of the host sparingly branched, 4.5–9 μ broad, the cells usually 2–10 times longer than broad, the surface-seeking branches subsimple or with fastigiate ramuli, three ramuli occasionally arising from a single cell; chromatophores 1–6, oblong, subcuneate, or somewhat discoid, often (especially towards the surface) confluent or single; hairs wanting (or very rare?); plurilocular sporangia simple or sometimes branched, short-cylindric, or ovoid, mostly 11–15 μ long and 4–6 μ broad, consisting of 1–6 (usually 3–5) discoid, subspheric, or subquadrate cells (2–4.5 μ high) in a single series, the distal ends of the sporangia even with those of the peripheral filaments of the host plant or slightly protruding; unilocular sporangia unknown. [PLATE 6, FIGURE B; PLATE 11, FIGURES 8–13.]

Forming conspicuous dark patches in *Grateloupia Cutleriae procera*, occupying the medulla of its host and reaching both surfaces about equally; water-front of Callao, Dec. 27, 1906, *Coker 17 p.p.* (type); also on same host (*Coker 37*) from La Punta, in the same general locality.

The species is possibly close to *Streblonema tenuissimum* Hauck, described as occurring "zwischen den Rindenfäden von *Nemalion lubricum* im adriatischen Meere," but we infer from Hauck's brief description that the Peruvian plant on *Grateloupia* is quite different in habit and that its very short, reduced, sometimes branched, plurilocular sporangia are different from the somewhat thicker "fadenförmig" sporangia of *S. tenuissimum*. *Streblonema minutissimum* Saunders (Proc. Washington Acad. Sci. **3**: 416. *pl. 45. f. 3.* 1901) in *Liebmannia* from Sitka, Alaska, has vegetative filaments that are only 1–2 μ in diameter and its plurilocular sporangia are more differentiated, more pointed, and are twice as long. *Streblonema minutulum* Heyd. (Ber. Deuts. Bot. Ges. **10**: 471. *pl. 26. f.*

15. 1892) in *Sebdenia ceylanica* from New Guinea has very different plurilocular sporangia or gametangia, which are finally about 4 cells broad and 8 cells long; hairs are also manifest. In the case of the Peruvian plant we have been able to find only one possible hair protruding from the cortex of its host and even that we have been unable to connect positively with the *Streblonema*.

PLATE 6, FIGURE B. *Streblonema radians*

Photograph showing the dark spots or patches caused by the *Streblonema* as they appear in a fragment of a dried specimen of its host, *Grateloupia Cutleriae procera*, natural size.

PLATE 11, FIGURES 8–13. *Streblonema radians*

8. Peripheral filaments, with plurilocular sporangia protruding very slightly from the surface of the host plant.
9. Two normal plurilocular sporangia of four cells each.
10. An irregularly branched or proliferous plurilocular sporangium of five cells.
11. A subumbellately branched plurilocular sporangium of five cells.
12 and 13. Portions of the *Streblonema* filaments from the medulla of the host plant, showing chromatophores, etc.

All of the figures are drawn from the type material (*Coker 17 p.p.*). Figures 8–12 are enlarged 675 diameters; 13, 390 diameters.

Streblonema Cokeri sp. nov.

Forming more or less penicillate tufts 150–800 μ broad or widely confluent, destitute of hairs; endophytic filaments mostly 50–400 μ long, 8–22 μ wide, often freely branched and usually interwoven and closely coherent; exterior filaments mostly 0.3–1.8 mm. long, 13–25 μ wide, usually simple or branched at the base only, commonly broadest near the middle and tapering gradually to the apex and often also to the base, often more or less dimorphous, one set short and slender, the other longer and coarser; cells 13–35 μ long, mostly 1–2 times as long as broad; chromatophores rather few, irregularly discoid or somewhat ribbon-shaped, commonly anastomosing and often confluent, occasionally numerous and rather regularly discoid; plurilocular "sporangia" dimorphous, the two forms on the same individual, terminal on the shorter and rarely on the longer filaments, also lateral on the longer filaments with 1- or 2-celled pedicels; microsporangia (antheridia?) elongate-ovoid to conic-cylindric, 38–102 $\mu \times$ 16–27 μ, often curved, subacute or obtuse, mostly 4–6 loculi in width, the loculi 2–4 μ in diameter; megasporangia (?) elongate-ovoid, fusiform or filiform, 38–105 $\mu \times$ 11–14 μ, 1 or 2 loculi in width, the loculi 5–11 μ in diameter. [PLATE 11, FIGURES 1–7.]

On and in *Codium tomentosum peruvianum*, Islands of Lobos de Afuera, March 27, 1907, *Coker 145 p.p.* (type); on and in

old and partially decayed thalli of *Spatoglossum crispatum*, same locality, date, and number; also, same locality and date, on and in *Prionitis decipiens* and its parasite *Lobocolax*, *Coker 144 p.p.*

The organs described above as "megasporangia" we have not observed in a certainly mature or dehiscent condition and it is possible that they represent immature or imperfectly developed states of the "microsporangia," but intermediate forms of these organs are so rare that we believe that the species possesses two kinds of plurilocular sporangia or gametangia, such as are described by Sauvageau for various species of *Ectocarpus*, even though a study of living material may be necessary before the species can be accurately compared with any of the types of reproduction described by that author.

The rhizoids or endophytic filaments penetrate the *Spatoglossum* as far as the medulla, surrounding the columnar or prismatic cortical cells; in the *Codium* they are longer, though rarely as long as the peripheral utricles of its host.

The exterior and erect filaments of the specimens on *Prionitis* and its parasite differ from those on *Codium* and *Spatoglossum* in bearing occasional short vegetative branches above the basal parts.

Streblonema Cokeri is perhaps as nearly allied to *S. Valiantei* (Born.) De-Toni as to any of the hitherto described species, but differs in the usually coarser filaments which appear never to end in hairs and in the narrower more elongate plurilocular "sporangia" (the largest 16–27 μ wide vs. 30–35 μ in *S. Valiantei*). Moreover, there are no indications that *S. Valiantei* has more than one kind of plurilocular "sporangia." *S. Valiantei* occurs at Biarritz on *Cystoseira ericoides*, on which it forms galls. *Streblonema Cokeri* is thus far known to occur only on *Codium* and *Spatoglossum*, on neither of which it forms galls.

Ectocarpus cylindricus Saunders (Proc. California Acad. Sci. III. Bot. 1: 150. *pl. 16.* 1898), which occurs on *Cystoseira* and *Codium* on the coast of California, is a taller plant (2–4 mm. vs. 0.3–1.8 mm.) with coarser filaments (18–30 μ vs. 13–25 μ); its plurilocular sporangia are larger (80–200 μ × 35–45 μ vs. 38–105 μ × 11–27 μ), and apparently show no tendency to dimorphism; it has also unilocular sporangia, which are not known in *Streblonema Cokeri*.

In *Streblonema Codii* E. S. Barton (Jour. Bot. 34: 194. 1896), growing on *Codium adhaerens* at the Cape of Good Hope, the scarcely exserted vegetative branches are only 60–90 μ long and 8–10 μ broad.

Ectocarpus simplex Crouan, as represented in Desmaz. Pl. Crypt. Fr. no. 1806, and *Ectocarpus virescens* Thuret, both of which occur on species of *Codium*, are so different from *Streblonema Cokeri* that a detailed comparison is unnecessary. Both of these, however, agree with *S. Cokeri* in having rhizoids that may be more or less "endophytic."

PLATE 11, FIGURES 1–7. *Streblonema Cokeri*

1. A tuft of filaments on apex of peripheral utricle of *Codium*.
2. Portion of a tuft showing basal branching, rhizoidal or endophytic filaments, etc.
3. A filament, showing form of cells, two microsporangia, etc.
4. An apical microsporangium, with a lateral supposed megasporangium below.
5. Portion of filament showing chromatophores and two lateral sporangia, of which the one on the right is supposed to be a microsporangium and that on the left a megasporangium.
6. A portion of a filament, showing form of cells and chromatophores.
7. A supposed megasporangium.

All of the figures are drawn from the type material on *Codium* (*Coker 145 p.p.*). Figure 1 is enlarged 15 diameters; 2–5, 7, 345 diameters; 6, 390 diameters.

Small specimens of *Ectocarpus* bearing a few plurilocular sporangia occur on *Desmarestia peruviana*, Ancón Bay, Feb. 13, 1907, *Coker 90 p.p.*, and on *Lessonia nigrescens*, Chincha Islands, June 18, 1907, *Coker 09612 p.p.*, but the material is rather too meager to justify an attempt at determination or description.

Family ENCOELIACEAE

COLPOMENIA (Endl.) Derb. & Sol. Mém. Phys. Alg. 11. 1856

COLPOMENIA SINUOSA (Roth) Derb. & Sol. loc. cit. [*C. sinuata* by misprint].

Ulva sinuosa Roth, Cat. Bot. 3: 327. *pl. 12.* 1806.

Encoelium sinuosum Kütz. Sp. Alg. 552. 1849; Tab. Phyc. 9: *pl. 8. f. I.* 1859.

Hydroclathrus sinuosus Zanard.; Mitchell, in Murray, Phyc. Mem. 53–56. *pl. 14; pl. 15. f. 1.* 1893.

C. sinuosa and *C. expansa* Saunders, Proc. California Acad. Sci. III. Bot. **1**: 164. *pl. 32.* 1898.

On rocks, San Lorenzo Island, region of Callao, Jan. 11, 1907, *Coker 5 p.p.*; Lobos de Tierra, Apr. 2, 1907, *Coker 151 p.p.*; Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09639 p.p.*: Isla Asia, Aug. 26, 1907, *Coker 241 p.p.*; from drift on the beach at Pisco, July 7, 1908, *Coker 465 p.p.*; on surf-washed rocks, Chincha Islands, July 13, 1908, *Coker 492 p.p.*

This widely distributed species appears to have escaped record hitherto as an inhabitant of the Pacific coast of South America though Dr. Coker's collections would indicate it to be not uncommon on the Peruvian coast.

PETALONIA Derb. & Sol. Ann. Sci. Nat. Bot. III. 14: 266. 1850

Phyllitis Kütz. Linnaea **17**: 97. 1843. Not *Phyllitis* Hill, Brit. Herbal 525. 1756.

Ilea Fr. Fl. Scan. 321. p.p. 1835. Aresch. Nov. Act. Soc. Sci. Upsal. **13**: 353. 1846. Nordst.* Bot. Notiser **1911**: 265. 1911. Not *Ilea* Fr. Syst. Orb. Veg. 336. 1825.

PETALONIA FASCIA (O. F. Müll.) Kuntze, Rev. Gen. Pl. 3: 419. 1898

Fucus Fascia O. F. Müll. Fl. Dan. 5^{13}: 7. *pl. 768.* 1778.

Laminaria Fascia Ag. Sp. Alg. **1**: 122. 1820.

Ilea Fascia Fr. Fl. Scan. 321. 1835. Nordst. Bot. Notiser **1911**: 265. 1911.

Phyllitis Fascia Kütz. loc. cit.

From rocks in the surf, Mollendo, August, 1908, *Coker 565 p.p.*

The specimens collected attain a length of 10 cm. and a width of 0.5–1.5 cm. They are commonly semifalcate (var. *curvata*

* *Phyllitis* being under the "Vienna Rules" and the "Brussels Amendments" the legal name for the genus of ferns usually known as *Scolopendrium*, Nordstedt has (loc. cit.) decided that *Ilea*, in current use for a genus of Ulvaceae, should be taken up for the genus of brown algae currently known as *Phyllitis*. This procedure, in spite of the confusion that it would entail, may be justifiable under the prevailing European rules of nomenclature, but the earlier use of *Ilea* in an entirely different sense happily forbids it under the "rejection of homonyms" principle of the "American Code."

Kütz.?), are rather thick and rigid (0.17–0.33 mm. thick), and are sometimes slightly ridged longitudinally on drying. Their rigidity and general habit would suggest the possibility of their being a young stage of some member of the family Laminariaceae, but the older plants are fertile and the reproductive organs as well as the general vegetative structure are of the "*Phyllitis*" type. The gametangia are slightly longer than in some forms of *Petalonia Fascia*, reaching a length of 40–50 μ.

Forms of *Petalonia* have been reported fromTierra del Fuego, Cape Horn, and the Straits of Magellan, but not hitherto from Peru, so far as we can discover.

Family DESMARESTIACEAE

DESMARESTIA Lamour. Essai 23. 1813

Spinularius Rouss. p.p. Fl. Calvad. 89. 1806 [ed. 2].
Herbacea Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 58, 89. 1809.
Hippurina Stackh. loc. cit. 59, 89.
Hyalina Stackh. loc. cit. 58, 88.
Desmia Lyngb. Tent. Hydroph. Dan. 33. 1819.
Dichloria Grev. Alg. Brit. xl. 1830.

DESMARESTIA PERUVIANA Mont. Fl. Boliv. 35. *pl.* 5. *f.* 3. 1839

? *Desmarestia affinis* Sond.; Kütz. Tab. Phyc. **9**: 41. *pl.* 97. *f.* c. 1859.

Dredged in Ancón Bay, Feb. 13, 1907, *Coker 90 p.p.* (a fragment only); in beach drift, Chimbote, Feb. 27, 1907, *Coker 108 p.p.* (considerably battered and nearly destitute of monosiphonous apices and branches).

The original collection of this species was made in the neighborhood of Callao by du Petit-Thouars and (unless *D. affinis* belongs here) we find no record of its collection during the nearly three quarters of a century that intervened between its original finding and Dr. Coker's investigations in Peru. Dr. Coker's specimens are imperfect but appear to be referable to *D. peruviana*. J. Agardh and De-Toni place *D. peruviana* under "species inquirendae." We believe that it is to be compared with the narrower forms of *D. ligulata*, from which it is apparently distinct, being less

regularly pinnate and the cells of the terminal and marginal filaments being commonly broader than long and often conspicuously inflated or subdolioform.

The narrower and less branched of the denuded forms found intermingled under Coker's 108 make a close approach to Kützing's figure of *Desmarestia affinis*, but the broader and more branched specimens under the same number are in general habit not far from the plant figured by Montagne, and we suspect that *Desmarestia peruviana* Mont. and *D. affinis* Sond. represent different forms and conditions of the same species.

Family MESOGLOIACEAE

MYRIOCLADIA J. Ag. Linnaea 15: 48. 1841

Myriocladia grandis sp. nov.

Thallus solid, flaccid, the main axes subterete and about 2 mm. in diameter just above the small basal disc, soon much flattened, 7–15 mm. wide,* 2–5 mm. thick, bearing few or rather numerous, irregularly disposed subdistichous branches, these subterete or the larger slightly complanate, 2–22 cm. long, 2–7 mm. broad, flexuous, simple or once or twice furcate or with a few short and irregular lateral ramuli, obtuse, slightly tapering or of nearly uniform diameter; peripheral assimilatory filaments mostly 0.5–1 mm. long, always much shorter than the diameter of the axes, mostly flexuous, simple, consisting of direct continuations of primary filaments of axis and also of their secondary subdichotomous, subsecund, or occasionally opposite or 3-verticillate ramuli, axial filaments on reaching periphery mostly 3–5 times closely subdichotomous, the major 14–22 μ broad, 50–60 cells long, their lower cells 2–4 times as broad as long, the upper commonly nearly isodiametric and submoniliform, terminal cells a little longer and soon deciduous; minor assimilatory filaments 8–11 μ broad, 10–30 cells long, their cells nearly isodiametric or often a little longer than broad; assimilatory filaments of an intermediate character intermingled with the "major" and the "minor"; colorless hairs apparently wanting; longitudinal filaments of the axis 11–32 μ in diameter, commonly separated by about their own diameter, usually more crowded in the center, occasionally anastomosing, subdichotomous; sporangia obovoid or pyriform, often curved at the base, 66–75 $\mu \times$ 38–44 μ, occasionally solitary but commonly in groups of 3–8, secund, alternate, or sometimes op-

* These measurements were made before drying and pressing.

posite or verticillate, usually sessile, occasionally with one pedicel cell, or rarely terminating a very short branch, often regenerating from base; peripheral assimilatory filaments occasionally showing median long-ellipsoidal, suborbicular or irregular swellings (abnormalities or plurilocular sporangia?) consisting mostly of two occasionally separated series of cells. [PLATE 12; PLATE 13, FIGURES 10–20.]

Washed ashore on a sand beach, Ancón, Feb. 13, 1907 (*Coker 93*, type); also, in two meters of water at Isla Vieja, Bahía de la Independencia (*Coker 09640 p.p.*).

The mode of growth in *Myriocladia grandis* appears to be essentially the same as described by Reinke for *Chordaria flagelliformis* and *C. divaricata*, with the assimilatory filaments both primary and secondary in origin. An application of the key to the genera of the Chordariaceae in the Engler & Prantl, "Die natürlichen Pflanzenfamilien," using the mode of growth as a distinguishing character, would throw the present plant into *Mesogloia* rather than *Myriocladia*, yet in the same work (p. 227) under *Myriocladia* we find "Sprossaufbau nicht bekannt." We have been unable to attempt any comparisons as to this character with the type species of *Myriocladia* (*M. Lovenii* J. Ag.), having no specimens of it, but *M. grandis* certainly differs much from the type of the genus *Mesogloia* [*M. vermiculata* (Sm.) Le Jol.] in being scarcely gelatinous, the peripheral filaments projecting far beyond the scanty mucus at their bases. The affinities of *M. grandis* would appear to lie with *M. Sciurus* Harv., which J. Agardh accepted as a member of his genus *Myriocladia*. But it differs from this Australian species, according to the published descriptions and figures, in its distinctly complanate main axis and in its relatively and actually much shorter peripheral filaments. We have no convincing evidence that what we have described as possible plurilocular sporangia are anything more than abnormal or exuberant developments in wholly vegetative filaments, but they have a certain resemblance to structures figured and described by J. Agardh as possible "trichosporangia" in *Myriocladia* and related genera.

PLATE 12. *Myriocladia grandis*

Photograph of the dried type specimen (*Coker 93*), about three eighths of the natural dimensions.

PLATE 13, FIGURES 10–20. *Myriocladia grandis*

10. Cross sections of the thallus (from fluid-preserved material).
11. A fascicle of peripheral filaments, with sporangia.
12. A part of a "major" assimilatory filament near its base.
13. Cells of the same filament near its middle.
14. Apical portion of a "major" filament.
15. Base of a "major" filament, with sporangia. The walls of many emptied sporangia persist and the large sporangium shown is still surrounded by the walls of a previous sporangium which it has replaced.
16. Base of a "minor" filament with remains of two sporangia.
17. Sporangia in various stages of development. The emptied sporangium at the right is being regenerated or refilled from its base; the lowest cell shown has the beginnings and remains of three sporangia subverticillately arranged.
18. Bases of a "major" and a "minor" filament, the former bearing a group of sporangia.

19, 20. Abnormalities or possibly abortive or immature plurilocular sporangia.

All of the figures are drawn from the type material (Ancón, *Coker 93*). The figures marked 10 are enlarged 2 diameters; 11, 55 diameters; 12–20, 345 diameters.

Family LAMINARIACEAE

EISENIA Aresch. Bot. Notis. 1876: 68. 1876; Obs. Phyc. 5: 7. 1884

Eisenia Cokeri sp. nov.

Gregarious; holdfast about 4–20 cm. in diameter, of compactly interlaced hapteres, these apparently without muciferous canals; stipe 2.5–9.5 dm. long, compressed-terete and 1–2 cm. broad at base, soon becoming more distinctly flattened and 1.5–3.0 cm. × 0.5 cm. above, solid, almost destitute of muciferous canals; primary lamina oblong or broadly linear, 20–30 (?) cm. long, smooth below, becoming longitudinally rugose and about 6 cm. broad above, once pinnate, the pinnae 6–8 on each margin, mostly rather closely crowded near the broadly canaliculate, cucullate or concavo-convex base, the 3 or 4 lowest (youngest) on each side subterete or ligulate, the succeeding 3 or 4 linear with narrow long-cuneate bases and gradually increasing in width to near their apices, 30–60 cm. long, 0.5–1 cm. wide below, becoming 1.5–4.5 cm. wide above, the highest pinnae short and subfalcate, 2–7 cm. long; primary lamina finally replaced by two flattened and often twisted crura mostly 2–25 cm. long and 1.5–5 cm. broad, each terminated by a subreniform commonly ruffled and twisted expansion 4–7 cm. broad and bearing 12–50 crowded sporophyls, these becoming 1–9 dm. long and 3–6 cm. broad from narrow long-cuneate bases, simple, or occasionally furcate, or rarely with one or two short lateral branches, 1–1.3 mm. thick near base, 0.3–0.55

mm. thick above, rather coarsely serrate, the surface strongly and coarsely rugose longitudinally, bearing rarely a submarginal series of teeth, otherwise without appendages, the larger of the marginal teeth bifid or bearing 1 or 2 smaller teeth; muciferous canals wanting or inconspicuous; sori soon confluent and forming a subcontinuous central band 1–3 cm. broad. [PLATE 14, FIGURE A; PLATES 15 and 16; PLATE 18, FIGURE A.]

In beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 28* (type); on the beach, San Lorenzo Island, Feb. 5, 1907, *Coker 71* (also in museum of Johns Hopkins University under *Coker 70*); "in the surf," Lobos de Tierra, Apr. 2, 1907, *Coker 151f;* also a photograph taken by Dr. Coker showing drift on the beach of Sechura Bay (PLATE 18, FIGURE A) with the following note: "For miles the beach was thus strewn with weed, and almost exclusively of one kind—a heavy brown corrugated-leaf weed (abundant in Bay at 5 fathoms)—similar to no. 71 and similar specimen included in 151."

Although it appears from Dr. Coker's photographs and notes that the plant described above was very abundant in Sechura Bay at least, the material originally sent by him to the present writer consisted of only one complete plant and parts of two others with stipe lacking. However, Dr. Coker secured at Callao a photograph of a group of well-developed plants (PLATE 14A) and some of the measurements given above have been drawn from this photograph, which, happily, included a tape-measure of known dimensions. No. 71, the complete plant, is immature and the primary blade still persists; it is shown, reduced, on PLATE 15, and the same individual is included also in the group photographed in Peru by Dr. Coker (PLATE 14A). The sporophyls in no. 151f are fertile.

From Dr. Coker and from Dr. G. Clyde Fisher (formerly of Johns Hopkins University) we have learned that several of the larger plants shown in PLATE 14, FIGURE A, were dried and sent to Johns Hopkins University as no. 70. These specimens, more or less mutilated, we have been permitted to examine through the courtesy of Professor Duncan S. Johnson and of Dr. G. Clyde Fisher and this examination has enabled us to complete and modify our first description in several particulars.

Eisenia Cokeri is closely related to the Californian *Eisenia*

arborea Aresch., and to the Japanese *Eisenia bicyclis* (Kjellm.) Setchell,* but in our judgment, it should bear a distinctive specific name, at least until such time as more proof of identity with these or other previously published species can be adduced than is furnished by the specimens now available. It apparently differs from both in several, perhaps minor, characters, such as the commonly longer stipe and the longitudinally rather than reticulately rugose sporophyls, but probably the most important distinctive character is found in the almost complete lack of muciferous canals in the stipe—organs that are very abundant and conspicuous in the stipes of both of the species hitherto recognized. At least, we have been able to find only two or three such canals in the four or five stipes examined—one of which stipes had attained a length of 95 cm. Nor have we been able to detect canals in the blade and pinnae of no. 71 or in the sterile sporophyls of no. 28, but in the fertile sporophyls of no. 151f small canals are occasionally found.

Eisenia Cokeri is perhaps an inhabitant of deeper waters than the Californian *E. arborea*. At least, Setchell† speaks of *Eisenia* at San Pedro and Redondo, California, as being "left partially bare by the fall of the tide," while Coker's note accompanying one of his photographs includes the remark, "abundant in the Bay at 5 fathoms."

That a plant so large and so abundant as *Eisenia Cokeri* evidently is, and, furthermore an inhabitant of the harbor of Callao, should escape collection and description would seem remarkable and almost improbable, yet we find no previous record of anything of the sort having been collected on the shores of Peru. There is to be considered, however, the *Laminaria biruncinata* Bory‡ described from Concepcion, Chile, a plant that is currently regarded as belonging to Turner's variety *exasperata* of the typically Australian *Ecklonia radiata* (Turn.) J. Ag.—a species in which the primary lamina is supposed to be persistent. *Laminaria biruncinata* is figured by Bory as having a bipinnatifid or subtri-

* Univ. California Publ. Bot. **2**: 129. 1905. *Eisenia arborea* Aresch. f. *bicyclis* (Kjellm.) Yendo, Bot. Mag. Tōkyō **16**: 206. 1902.

† Erythea **4**: 131. 1896.

‡ Dict. Class. Hist. Nat. **9**: 190. 1826; Voy. Coquille, Bot. Crypt. 101. *pl. 10.* 1828.

pinnatifid thallus. It bears little resemblance to the youngest stage of the Peruvian plant that we have seen (PLATE 15) and still less to the older forms and we think it probable that it represents a true *Ecklonia* as has been generally supposed. *Laminaria biruncinata* is figured as having the surface of its lamina covered with teeth and difform processes, while *Eisenia Cokeri* is free from such outgrowths if one may except rarely occurring submarginal teeth.

PLATE 14, FIGURE A. *Eisenia Cokeri*

Photograph of a group of plants collected on the beach of San Lorenzo Island, near Callao. (Photograph from Dr. Coker.)

PLATE 15. *Eisenia Cokeri*

Photograph of a young specimen (from liquid preservative—*Coker 71*) collected on beach of San Lorenzo Island, a little less than one fourth of the natural dimensions.

PLATE 16. *Eisenia Cokeri*

Photograph of a fragment (from liquid preservative—*Coker 28*) collected at La Punta, region of Callao, showing one of the supercrural expansions and the basal parts of the sporophyls springing from it; about two fifths of the natural dimensions.

PLATE 18, FIGURE A. *Eisenia Cokeri*

A photograph, taken by Dr. Coker, showing beach drift on Sechura Bay. This drift is said by him to consist almost exclusively of the kelp here described as *Eisenia Cokeri.*

An undetermined "*Laminaria*" from Ancón near Callao is listed by Piccone (Alg. Vettor Pisani 37. 1886).

LESSONIA Bory, Dict. Class. Hist. Nat. **9**: 321. 1826

LESSONIA NIGRESCENS Bory, loc. cit. 322; Voy. Coquille, Bot. Crypt. 80. 1827; *pl. 5*. 1828. Post. & Rupr. Illust. Alg. 3. *pl. 4*. 1840. Skottsberg, Schwed. Sudpol.-Exp. 4^6: 69–72. *f. 81–88*. 1907

Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 09150 p.p.*; Chincha Islands ("common, with short stems attached to vertical surfaces of rocks in surf by stout tangled holdfasts"), June 18, 1907, *Coker 197* and *09612* (PLATE 17).

The plants reach a length of a little more than a meter and are 4–6 times dichotomous; the main stipe is 0.75–1.5 cm. in diameter, is strongly flattened from the base and the bases of originally

independent plants apparently anastomose more or less; the first dichotomy may be almost at the base itself or 4–5 cm. above; the blades are 8–30 mm. wide and their margins have rather obscure blunt teeth or are subentire; some of the blades are fertile, the sori forming irregular longitudinal, commonly median, bands or blotches 5–16 mm. wide.

Nos. 09150 p.p. and 09612 appear to be entirely destitute of muciferous canals, both as to blades and stipes, and from Bory's figures of sections of the stipe, one may infer that the same condition obtains in the stipe, at least, of his Cape Horn type of the species. But in Dr. Coker's 197, collected on the same day and in the same locality as his 09612, and agreeing with it essentially in size and habit, muciferous canals are abundant in the blades and in the greater part of the stipe, becoming obscure, however, towards the extreme base. In the blade these muciferous canals are often large and conspicuous, sometimes extending from the epidermis nearly to the compact medulla. It is possible that 197 and 09612 represent two closely allied species standing in about the same relation as *Laminaria saccharina* (L.) Lamour. and *L. Agardhii* Kjellm., but more material would be needed to establish any such conclusion. No. 197 certainly has the form and size of *L. nigrescens;* it has not the dendroid habit of *L. fuscescens* Bory or the broad blades of *L. ovata* Hook. f. & Harv.,* both of which are attributed to the Pacific coast of South America. And it is to be noted that Hooker and Harvey apparently attribute muciferous canals to the stipe of *L. nigrescens*, remarking† that they ["air-cells"] are "copious in the stems of the former [*L. fuscescens*], and much rarer in the latter [*L. nigrescens*]" and in their figure‡ of a cross section of a fertile blade of *L. nigrescens* they represent numerous large cavities that can hardly be anything other than muciferous canals. Guignard§ finds muciferous canals sometimes present in stipe and blade and sometimes entirely wanting in specimens of *Lessonia nigrescens* coming from the collections of Bory and of Lamouroux, and he suspects that there may have been some con-

* Skottsberg (loc. cit. 73) unites *L. fuscescens* and *L. ovata* under *L. flavicans* Bory, which seems to be the oldest name for what is currently known as *L. fuscescens*.

† Fl. Antarct. 460. 1846.

‡ Loc. cit. *pl. 167–168. f. c.*

§ Ann. Sci. Nat. Bot. VII. 15: 44. 1892.

fusion of species. Skottsberg* finds muciferous canals in both stipe and blade of the specimens that he refers to *L. nigrescens*, but J. Agardh† finds no "lacunae" in what he considers the true *L. nigrescens*. More copious material and a thorough examination of the types of Bory and other writers would be necessary for a wholly satisfactory disposition of Dr. Coker's Peruvian Lessonias.

PLATE 17. *Lessonia nigrescens*

Photograph of a specimen (from liquid preservative—*Coker 09612*), collected on rocks in surf, Chincha Islands; a little less than one sixth of the natural dimensions.

Montagne (Voy. Bonite, Bot. Crypt. 38) attributed *Lessonia fuscescens* to Callao on the strength of a "specimen mancum foliisque orbatum legit cel. Gaudichaud."

Lessonia Suhrii J. Ag. (Linnaea **15**: 4. 1841; Sp. Alg. **1**: 150. 1848), originally described from Chile, has been attributed to Peru by Grunow (Reise Novara Bot. **1**: 51. 1867). It is described by J. Agardh as having "folia 4–6 pollicaria, 2 lineas circiter lata." Nothing that seems to resemble it closely occurs in Dr. Coker's collections.

MACROCYSTIS Ag. Sp. Alg. 1: 46. 1820

MACROCYSTIS INTEGRIFOLIA Bory, Dict. Class. Hist. Nat. **10**: 9. 1826. [As *M. integrifolius*]

Macrocystis integrifrons α Bory, Voy. Coquille, Bot. Crypt. 87. 1827; *pl. 6. f. a.* 1828.

Macrocystis zosteraefolia Ag. Act. Acad. Caes. Leop.-Car. **19**: 301. *pl. 28. f. 13.* 1835.

Macrocystis angustifolia Aresch. Obs. Phyc. 4: 22. 1883. De-Toni, p.p. Syll. Alg. **3**: 371. 1895. Not *Macrocystis angustifolius* Bory, Dict. Class. Hist. Nat. **10**: 9. 1826 (as to the technical "type," which was from New Holland.)

On surf-washed rocks, Chincha Islands, June 12, 1907, *Coker 09600* (PLATES 20 and 21) and *09614* (PLATE 19); floating, Callao Bay, Feb. 26, 1907, *Coker 09166* (PLATE 22). More or less of the material under all of these numbers is fertile.

The excellent specimens secured by Dr. Coker incline us to

* Loc. cit.

† Anal. Alg. Cont. **2**: 88. 1894.

adopt the view of Areschoug and others that there are at least two reasonably distinct species of *Macrocystis* on the western coast of South America. If intermediates occur, the fact is not shown by Dr. Coker's specimens.* There is, 1st, the long plant (commonly 6 meters or more) of rather deep water (5 meters or more), with separate or isolated holdfasts, broad thin blades, and commonly subglobose vesicles—the *Fucus Humboldtii* of Bonpland, which is probably only a form of *M. pyrifera* (L.) Ag.; and 2d, the short plant (2–3 m. long) that grows gregariously on surf-swept rocks at or just below the low-tide mark, with densely intertangled rhizomatous holdfasts, narrowly linear, usually subentire thick blades, and commonly elongate vesicles (mostly 1½–4 times as long as broad).† The latter is doubtless the plant known to Areschoug ‡ as *Macrocystis angustifolia* Bory, but the plant on which Bory based most of his description of "*Macrocystis angustifolius*" and which he soon afterwards figured under the slightly modified specific name *angustifrons* came from Australia and appears to differ little from the typical *M. pyrifera* except in its narrower blades. The earliest distinctive name for the small, narrow-leaved shallow-water plant of the western coast of South America, in the specific category at least, appears to be Bory's "*Macrocystis integrifolius*," which name is perhaps unfortunate, as the absence of marginal teeth is rather less constant and characteristic than the narrowness of the blades.

In one of Dr. Coker's specimens, 09166 (PLATE 22), found floating and lacking the holdfast, though probably representing practically the whole plant, the plant is 2.2 m. long and the stipe is slightly compressed or subterete; the blades are entire-margined (except the fertile basal), are smooth, narrowly linear, 7–12 cm.

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* Dr. Coker himself, however, (in litt.) inclines to the opinion that the two forms represent "individual adaptations within the species."

† The medulla, as seen in a cross section of the stipe, is usually much more compressed in the narrow-bladed plant than in the broad-bladed, but this varies in different parts of the plant and seems to be a rather unstable character.

‡ In the Chilean plant figured by Postels and Ruprecht as *M. angustifolia* (Illust. Alg. 3. *pl. 5.* 1840), many of the blades are represented as plicate or rugose, while in Dr. Coker's Peruvian plants, they are smooth and plane throughout; and the marginal teeth also, are represented as numerous and subulate or cilium-like, while in these Peruvian plants, they are, when present, short and usually very blunt or truncate.

long, 6–9 mm. wide, narrower than the vesicles or equaling them in maximum width and 0.35–0.5 mm. thick; the vesicles are cylindric-ellipsoid, 3.5–4.5 cm. × 1.1–1.4 cm., 2–5 times as long as their maximum width; muciferous canals are abundant in the blades but rare or inconspicuous in the stipe; cells of the inner cortex of blades 25–55 μ in diameter in cross section, rather thick-walled; the two lowest blades are compound, if they may be properly so described, and are fertile, the higher with a short vesicle in the common stalk and the lower without a vesicle (comparison with other specimens collected by Dr. Coker indicates that these two compound fertile blades were close to the holdfast and were probably the two lowest blades of the plant); each of these compound blades consists of four lanceolate or linear-lanceolate obscurely denticulate fertile bladelets, each with a short median cleft at its base; the sori are continuous and occupy the greater part of the basal half of the bladelets or are occasionally limited to a transverse band near the middle of the bladelet.

Dr. Coker's numbers 09600 and 09614 have admirably preserved holdfasts that were evidently chopped out with a hatchet or strong knife from where the plants were growing "on surf-washed rocks."* In 09614, a mass of closely interwoven rhizomes and hapteres measuring 12 × 8 × 4 cm. (PLATE 19) was cut out, but the individual rhizomes are shown better by his no. 09600, in which the interwoven mass is less dense and thick. A blocked-out portion of the latter is shown in our PLATE 20.

In numbers 09600 and 09614, the fertile and apparently full-grown plants attain a length of 2–3 m.; the vegetative blades are smooth, linear (or some of the lower linear-lanceolate), mostly 15–25 cm. long, 5–24 mm. wide, a little narrower or broader than the vesicles or equaling them, 0.3–0.4 mm. thick, the margins of the lower blades with numerous short (1 mm. or less), mostly blunt, truncate or capitate, brownish and indurated teeth, those

* Under 09614, Dr. Coker has the following note: "A very abundant weed attached by holdfasts to vertical rocky shores. The islets and rocks have a fringe of this weed continually waving and streaming about in the swirling currents of the surf. This form and 09612 [*Lessonia nigrescens*] are found together." In response to a request for more detailed information as to the depth at which these plants were growing Dr. Coker writes, "I can say with assurance (from memory) that the holdfasts were exposed by the receding waves but I do not remember to have seen them above the *reach* of the water at any stage of the tide."

of the upper blades obscurely denticulate, crenulate, or entire; muciferous canals and parenchyma cells as in 09166; the vesicles are long-ellipsoid, clavate-ellipsoid, clavate-pyriform, or subpyriform, mostly 1.5–4 cm. × 0.8–1.5 cm., 1½–4 times as long as their greatest width; the sori, so far as observed, are confined to one or two compound basal blades (PLATE 21). The lowest of these blades are destitute of vesicles; some of the higher may be provided with them; the compound blade usually consists of four bladelets or sporophyls, but two and three occur, especially very close to the base of the plant; the sori occur on both sides of the sporophyl and form large blotches or cover continuously a large part of the surface of the sporophyl.

Macrocystis has been generally supposed to be an inhabitant of 2–30 meters of water (low tide). Hooker and Harvey* say of it that "One thing alone it requires, and that is, a mean depth of six or more fathoms." Setchell† refers to its occurrence on the Pacific coast of North America in "20 to 30 meters depth of water." McFarland‡ states that "it grows on rocks off the coast in from 5 to 15 fathoms of water, generally." Crandall,§ however, has observed it off the southern coast of California in "2½ fathoms," though the holdfast is there attached "at a depth of, usually 4 to 10 fathoms." But the shallowest water from which *Macrocystis* has hitherto been actually recorded seems to be at Moss Beach, San Mateo Co., California, where Setchell, according to Hoffman,‖ collected fertile specimens growing where "very nearly uncovered at the lowest tide."

PLATE 18, FIGURE B. *Macrocystis integrifolia*

A photograph, taken on the Chincha Islands by Dr. Coker, showing this kelp *in situ*, near the low-tide line.

PLATE 19. *Macrocystis integrifolia*

A photograph, showing massively interwoven rhizomes and hapteres, etc., natural size, (*Coker 09614*, from material preserved in liquid).

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* In Hooker, J. D. Flora Antarctica 461. 1846.

† Setchell, W. A. The kelps of the United States and Alaska, in Fertilizer resources of the United States, Senate Document No. 190, 62d Congress, p. 159. 1912.

‡ McFarland, F. M. The kelps of the central Californian coast. Loc. cit. 200.

§ Crandall, W. C. The kelps of the southern Californian coast. Loc. cit. 211.

‖ Hoffman, E. J. Fructification of *Macrocystis*. Univ. California Publ. Bot. 4: 154. 1911.

PLATE 20. *Macrocystis integrifolia*

A photograph, showing basal bladderless sporophyls and a single rhizome from which four erect shoots arise (*Coker 09600*), natural size. The stipe that is somewhat in the foreground comes from a branch of the main rhizome.

PLATE 21. *Macrocystis integrifolia*

A photograph, showing two compound sporophyls and the arrangement of the sori. The lower of the two compound blades lacks a vesicle, while the higher one (on the same plant) is provided with a well-developed vesicle. About four fifths of the natural dimensions. Photograph from a fluid-preserved specimen (*Coker 09600*).

PLATE 22. *Macrocystis integrifolia*

Photograph of a specimen found floating (*Coker 09166*—from liquid preservative), showing much elongated vesicles, narrow entire or subentire blades, basal compound sporophyls, etc.; a little more than one third of the natural dimensions.

MACROCYSTIS PYRIFERA HUMBOLDTII (Bonpl.) Hook. f. & Harv. in Hook. f. Fl. Anarct. 461. 1846

Fucus Humboldtii Bonpl. in Humb. & Bonpl. Pl. Aequin. **2**: 7. *pl. 68.* 1808.
Fucus hirtus Humb. & Bonpl. loc. cit. 9. *pl. 69.*
Laminaria pomifera Lamour. Essai 22. 1813.
Macrocystis Humboldtii Kunth, Syn. Pl. Aequin. **1**: 6. 1822.
Macrocystis Humboldti Ag. Syst. Alg. 293. 1824.

"Dredged in 2½ fathoms," "the common large weed of the Bay, being taken regularly in scallop dredges," Island of San Lorenzo, region of Callao, Feb. 5, 1907, *Coker 60* (PLATE 23); Bahía de la Independencia, July 19, 1907, *Coker 09613, 09632, 09633, 09635* (PLATE 24)—"attached to rocks or to large mussels at the bottom; the largest piece measured 10 meters and the entire single cluster weighed 30 lbs."

The type of *Fucus Humboldtii* came from the Peruvian coast and Dr. Coker's specimens agree closely with the original illustration except that the plants are larger and the blades often broader. Two of the specimens show the holdfasts, which form compact masses of nterlaced hapteres 3–5 cm. in diameter, cup-shaped below from having overgrown shells (PLATE 23). In these two numbers with holdfasts (*60* and *09633*), sori are found on modified, bladderless, usually compound, basal blades in about the same fashion as figured by Saunders* and by Hoffman† for *Macrocystis*

* Proc. Washington Acad. Sci. **3**: *pl. 60.* 1901.
† Univ. California Publ. Bot. **4**: *pl. 20.* 1911.

pyrifera from the western coast of North America and about the same also as the first type figured by Skottsberg* for the same species from South Georgia.

These basal sporophyls bear numerous long (2–5 mm.) flexible filiform teeth, very different from the short rigid teeth of the sporophyls of *M. integrifolia*.

Dr. Coker's 09635, which was evidently a detached floating fragment, is of especial interest for the reason that its nine blades are all fertile, seven of these nine having the ordinary vegetative form with normal pyriform or subglobose air-vesicles (PLATE 24). The two blades that lack individual vesicles (see photograph) stand nearly opposite each other at one end of the floating stipe or stem, which is somewhat enlarged and bladder-like at this point. This was evidently the distal or apical end of a segment of the plant that was broken off both proximally and distally and it seems probable that the two blades without proper vesicles were formed by regeneration† from this broken-off apical end. Parts of five of the nine leaves of this fragment are shown in PLATE 24. The sori occur on one or both surfaces and mostly in the basal half of the blade and usually take the form of oblong, suborbicular or very irregular brownish blotches 2–5 mm. in diameter, which remain isolated and separate in the upper and marginal portions of the fertile areas, but become confluent in the basal and median portions; in some of the blades, however, the sorus is continuous, but in these cases is confined to the extreme base of the blade. The surface of the blades is smooth or very lightly wrinkled, as in all the Peruvian forms of *Macrocystis* that we have seen, and we have, accordingly, observed no approach to any limitation of sori to the bottoms of grooves and furrows as described and figured by Smith and Whitting‡ and by Skottsberg.§ Setchell and Gardner‖ have referred to Peruvian specimens in which sori occur "on leaves near the tip and provided with bladders" and what are presumably the same specimens have been referred to again by Edna

* Schwed. Sudpol.-Exp. 4^6: *f. 123*. 1907.

† Compare: Setchell, W. A. Regeneration among kelps. Univ. California Publ. Bot. 2: 139–168. 1905.

‡ Phyc. Mem. 85. *pl. 20. f. 1, 2*. 1895.

§ Loc. cit. 105. *f. 125, 126*.

‖ Univ. California Publ. Bot. 1: 270. 1903.

Juanita Hoffman, who has recently reviewed the scanty literature relating to fructification of *Macrocystis*.*

The plants that we are here referring to *Macrocystis pyrifera Humboldtii* have subterete or slightly compressed stipes, subglobose or pyriform vesicles, and smooth or slightly wrinkled blades that are only 0.13–0.30 mm. thick; the cells of the inner cortex of the blade are large (40–90 μ in cross section) and are rather thin-walled; muciferous canals are common in the stipe but seem to be rare or inconspicuous in the blades, which is the reverse of what obtains in *M. integrifolia*.

This form of *Macrocystis* was collected in Peru (in 1839) by the Wilkes Expedition, according to specimens in the herbarium of Columbia College, and what is presumably this form has been reported from Callao under the name *M. Humboldtii* by Montagne (Fl. Boliv. 35. 1839) and by Piccone (Alg. Vettor Pisani 38. 1886).

PLATE 14, FIGURE B. *Macrocystis pyrifera Humboldtii*

Photograph (from Dr. Coker) showing a specimen collected in the region of Callao.

PLATE 23. *Macrocystis pyrifera Humboldtii*

Photograph of the basal part of a young specimen (*Coker 60* p.p.—from liquid preservative) showing holdfast attached to a shell, immature basal bladderless sporophyls, the flexible filiform marginal teeth, etc. About one third of the natural dimensions. (The bullae on vesicles and blades are due to imperfect preservation.)

PLATE 24. *Macrocystis pyrifera Humboldtii*

Photograph of a floating fragment (*Coker 09635*), showing sori on blades of the ordinary vegetative form, about one third of the natural dimensions.

Family FUCACEAE

SARGASSUM Ag. Sp. Alg. 1: 1. 1820

SARGASSUM PACIFICUM Bory, Voy. Coquille, Bot. Crypt. 123. 1828

Bay of Ferrol (Chimbote), floating, Feb. 28, 1907, *Coker 110;* in same locality, "on tide rocks," Mar. 1, 1907, *Coker 117;* Lobos de Afuera, Dec. 5, 1907, *Coker 279* (attached—PLATE 25).

Plants 20–30 cm. long, densely or rather loosely foliose; leaves

* Univ. California Publ. Bot. 4: 151–158. *pl. 20.* 1911. She overlooks, however the principal contribution to the subject, published by Skottsberg four years earlier. Dr. Skottsberg's paper "Zur Kenntnis der subantarktischen und antarktischen Meeresalgen. I. Phaeophyceen" includes the most complete and detailed monograph of *Macrocystis* yet written (Schwed. Sudpol.-Exp. 4^6: 80–139. *pl. 9+f. 91–170.* 1907).

15–35 mm. long, 6–10 mm. broad, mostly undulate-crisped, the margins sinuate-lobed, obscurely and irregularly or sometimes deeply dentate, or subentire, the short petiole often bearing 1–3 tooth-like appendages, cryptostomata inconspicuous or almost wanting; vesicles small, ovoid, or obovoid, muticous, 3–5 mm. long, on pedicels of about equal length; receptacles cymose, 2–5 times subdichotomous, 5–7 mm. long, congested in the axils of the leaves, the ultimate branchlets conic-cylindric or short-finger-shaped, 2–4 mm. long, often roughened by developing sporelings.

In general habit, *Sargassum pacificum* somewhat resembles the West Indian *S. foliosissimum* (Lamour.) Vickers (which is perhaps the oldest valid name for the rather indefinite thing currently known as *Sargassum vulgare* Ag., though Lamouroux's *Fucus foliosissimus* was published by illustrations rather than by diagnosis). It differs, however, from the typical *S. foliosissimum* in the almost complete absence of cryptostomata, the longer and commonly less dentate leaves, etc.

Bory's type specimen of *Sargassum pacificum* was collected at Concepcion, Chile, in 1823, and is now preserved in the Muséum d'Histoire Naturelle in Paris; its leaves are 15–40 mm. long and 4–8 mm. wide, the margins sinuate, subentire, or sparingly dentate, the petioles sometimes bearing one or two teeth, the cryptostomata almost wanting; vesicles subglobose or slightly obovoid, 2–3 mm. long on stalks of equal length, mucronate when young but soon muticous; receptacles 3–5 times subdichotomous, congested in the axils of the leaves, the ultimate branchlets conic-cylindric or digitiform, 2–5 mm. long.

PLATE 25. *Sargassum pacificum*

Photograph of a complete fertile specimen (from liquid preservative—*Coker 279*), reduced to a little less than one half of the natural dimensions.

"*Fucodium fastigiatus*" is attributed to the coast of Ancón, Peru, by Piccone (Alg. Vettor Pisani 40. 1886).

Family DICTYOTACEAE

SPATOGLOSSUM Kütz. p.p. Linnaea 17: 97. 1843; Phyc. Gen. 339. 1843. J. Ag. Till Alg. Syst. 2: 111. 1880; Anal. Alg. Cont. 1: 45. 1894

Spatoglossum crispatum sp. nov.

Stupose for 2–4 cm. at base, mostly 15–25 cm. long, 3–8 times dichotomous or subdichotomous or somewhat laterally branched at the subcostate base, often with short rigid crisped and congested basal branches; main segments mostly linear, 10–25 mm. broad, usually obtuse, rather coriaceous and mostly 250–420 μ thick when fresh, papyraceous or subcoriaceous when dry, the margins, at least in the lower half, crenulate-crisped, rather rigid and brownish, becoming subentire or minutely crenulate above; interior or medullary stratum mostly 3–6 cells thick, the cells 30–240 μ in longer diameter in a transverse section; basal or subbasal costa showing in a cross section 6–10 series of smaller subquadrate cells in regular vertical rows bordering the medulla on either face; surface of thallus not zonate and scarcely areolate, the cortical cells rather obscurely grouped in irregularly rhombic areas bounded by colorless intercellular lines, the cells almost homogeneous in form and size, subquadrate or oblong and 13–40 μ in maximum diameter in surface view, columnar or rectangular-oblong and 30–80 μ high in a vertical section, mostly 1.5–3 times as high as broad; tetrasporangia ovoid with longest diameter perpendicular to the surface, 70–125 μ high, 42–96 μ in greatest width. [PLATE 13, FIGURES 1–4; PLATE 26.]

Islands of Lobos de Afuera, Mar. 27, 1907, *Coker 145 p.p.* (type); Lobos de Tierra, Apr. 2, 1907, *Coker 150 p.p.*

Spatoglossum crispatum evidently belongs in the section of the genus that includes *S. Schroederi* (Mert.) Kütz. (p.p.) and *S. Areschougii* J. Ag., but appears to differ from both of these species in the firmer more rigid thallus, the crisped-crenulate instead of plane dentate or proliferous margins, the more costate base, the medullary stratum mostly 3–6 instead of 2 or 3 cells thick, the smaller more homomorphous cortical cells, the marked vertical elongation of the cortical cells and sporangia, etc. The striae of cortical cells that J. Agardh mentions as characteristic of the *S. Schroederi* section appear to be lines of narrower darker cells such as bound his "fenestrae" in the surface of certain species of

Dictyota. Such specialized cortical cells and the resulting areolations or striations seem to be of rare occurrence in *S. crispatum*, though they are occasionally found near the margins. However, the cortical cells, viewed from the surface, show, more or less clearly, a grouping in rhombic areas bounded by hyaline lines.

We have seen and photographed the type specimens of both *Spatoglossum Schroederi* (type from Brazil) and *S. Areschougii* (type from Pernambuco) in the Agardh herbarium, but have not examined them microscopically. For the above comparisons as to cell structure we have relied upon West Indian and Floridian specimens that seem referable to these species.

Possibly an incomplete specimen from the Galapagos Islands, referred by Piccone, with some doubt [Mem. R. Accad. Lincei IV^a. **6**: -(17). 1889] to *Spatoglossum Schroederi*, belongs here, but we have not seen it. Montagne (Fl. Boliv. 34. 1839) also mentions *Zonaria Schroederi* as occurring at Cobija, at that time in Peru, but now in Chile.

An old and decaying fragment of a frond bears, besides numerous epiphytes, many sporelings of the *Spatoglossum* which have developed on the surface of the frond. These are at first filiform or clavate, later oblanceolate, obovate, or subspatulate.

PLATE 13, FIGURES 1–4. *Spatoglossum crispatum*

1. A portion of the thallus margin of a tetrasporic plant.
2. A portion of a cross section of thallus, showing young tetrasporangia, etc.
3. Outlines of cross sections of the thallus; the lower from near the base and of costa-like structure; the upper taken 3 or 4 cm. above the base and showing a more clearly defined costa and lamina.
4. Cross section through costa near base.

All of the figures are drawn from the type material (Islands of Lobos de Afuera, *Coker 145 p.p.*). Figures 1 and 3 are enlarged 9 diameters; 2 and 4, 68 diameters.

PLATE 26. *Spatoglossum crispatum.*

Photograph of type specimen (*Coker 145 p.p.*—from liquid preservative), natural size.

NEUROCARPUS Web. & Mohr, Beitr. Naturk. **1**: 300 (242–246). 1805

Dictyopteris Lamour. Nouv. Bull. Sci. Soc. Philom. **1**: 332. My 1809; Jour. de Bot. **2**: 129. 1809.* Kjellm. in Engler & Prantl,

* The compilers of the list of "nomina conservanda" adopted by the Brussels Congress prefer to retain the name *Dictyopteris* for this genus, but inasmuch as *Neurocarpus* was established in a manner that complies fully with the generally

Nat. Pflanzenfam. 1^2: 296. 1896.

Polypodoidea Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 96, 97. 1809.

Halyseris Ag. Sp. Alg. **1**: 141. 1820. J. Ag. Till Alg. Syst. **2**: 131. 1880; Anal. Alg. Cont. **1**: 42. 1894. De-Toni, Syll. Alg. **3**: 253. 1895.

Neurocarpus Cokeri sp. nov.

Brownish-green, 30–40 cm. long, arising from a short stupose base 2–3 mm. in diameter, the costa tomentose for 3–8 cm., then naked, percurrent or evanescent towards the apices, 4–8 times subdichotomous, the forkings mostly at angles of 30–45°, the main segments 15–45 mm. broad; lamina very thin-membranous and friable, 30–125 μ thick, often perforate, subpersistent below, forming narrow wings for 2–8 cm. in basal parts, usually 4 cells thick, but often with more or less broad uni- or bistratose borders, the margins subentire or here and there irregularly ciliate-dentate, toward the apices commonly subpinnately much lobed, lacerate, incised, or erose, or often with linguiform proliferations; veins wanting or very rudimentary; trichomes from the lamina deficient or rare; cells of the surface of the mature lamina mostly subquadrate-oblong, 40–96 μ × 27–55 μ, those of the surface of the costa usually a little narrower, all with very numerous subspheric chromatophores; cells of the interior of lamina 27–96 μ × 22–27 μ in cross section, with scattered chromatophores; costa 0.25–1.25 mm. wide, 4–16 cells in maximum thickness; oogonia scattered, single or in groups of 2–5, ellipsoid, cuboid, or subspheric, 95–137 μ × 40–68 μ. [PLATE 13, FIGURES 5–9; PLATE 27.]

Bay of Sechura, April 10, 1907, *Coker 170*; a single plant dredged in about 10 m. of water. The color of the plant, as it comes to us, is a bright almost ulvoid green, but this character has doubtless undergone modification through the action of the preserving fluid, for Dr. Coker's notes refer to the specimen as "brownish."

Neurocarpus Cokeri, in point of size, ranks with the largest species of the genus, such as *N. Justii* (Lamour.) Kuntze, *N.*

recognized laws of nomenclature and enjoys a priority of four years and inasmuch as recent usage has favored *Haliseris* (or *Halyseris*) rather more than *Dictyopteris*, there seems to be in this case at least no valid and sufficient reason why the law of priority should not be allowed to determine the choice of the generic name. The dating of *Dictyopteris* back to "1805" by the compilers of the list of "nomina conservanda" is evidently incorrect.

australis (Sond.) Kuntze, *N. Muelleri* (Sond.) Kuntze, and *N. membranaceus* (Stack.) Kuntze, but it perhaps deserves comparison with the medium-sized Californian **N. zonarioides** (Farlow)* rather than with any of the others named. Besides being 2–4 times as large in its general gross dimensions as the largest specimens of *N. zonarioides* that we have seen, the surface cells of the usually more delicate lamina of *N. Cokeri* have diameters 2–3 times as great, the lamina is remarkably destitute of hairs, and there are often considerable areas along the margins that are only 1 or 2 cells thick, a character that we have not observed in *N. zonarioides*, in which, also, we have not noted marginal innovations. In the laciniate-incised character of lamina in the mature plants there is a certain degree of similarity between the two species, yet this peculiarity appears to belong more exclusively to the apical portions in *N. Cokeri* than in *N. zonarioides.* It is probable that the color of *N. Cokeri* is lighter or greener than that of the Californian species, but of this, from the nature of the material, we are hardly able to judge.

PLATE 13, FIGURES 5–9. *Neurocarpus Cokeri*

5. A portion of the surface of the thallus, showing oogonia and outlines of the surface cells.
6. Outlines of the cells of the surface of lamina near base of plant.
7. A cross section showing the usual structure of the margin of the lamina.
8. A cross section showing a unistratose margin in a rather young part of the thallus.
9. A unistratose margin near the base of the plant, in surface view.

Figures 5 and 6 are enlarged 68 diameters; 7–9, 245 diameters.

PLATE 27. *Neurocarpus Cokeri*

Photograph of the dried type specimen (*Coker 170*), about two fifths of the natural dimensions.

DICTYOTA Lamour. Nouv. Bull. Sci. Soc. Philom. **1**: 331. My 1809; Jour. de Bot. **2**: 38. 1809. J. Ag. Till Alg. Syst **2**: 83. 1880; Anal. Alg. Cont. **1**: 45. 1894

DICTYOTA DICHOTOMA (Huds.) Lamour. Jour. de Bot. **2**: 42. 1809

Ulva dichotoma Huds. Fl. Angl. 476. 1762.

"From an estero (salt creek) known as Río Zarumilla, near

* Comb. nov. (*Dictyopteris zonarioides* Farlow, Erythea **7**: 73. 1899.)

Capón, six miles from ocean; density 1022–24; Feb. 2, 1908"; region of Tumbes; *Coker 344 p.p.*

Segments tetrasporic, sometimes 4–6 mm. broad but often only 1.5–2 mm., 82–95 μ thick; apices obtuse; surface cells 14–50 μ $\times$ 10–25 μ. The segments are sometimes as narrow as those of the plants currently referred to *Dictyota Fasciola** but they are less attenuate and are not at all twisted.

Dictyota dichotoma has been reported by Montagne (Fl. Boliv. 34. 1839) from Cobija, once in Peru but now in Chile.

GLOSSOPHORA J. Ag. Till Alg. Syst. 2: 108. 1880

GLOSSOPHORA KUNTHII (Ag.) J. Ag. loc. cit. 110

Zonaria Kunthii Ag. Icon. Alg. Ined. 2: *pl. 15.* 1821.

In beach drift, La Punta, region of Callao, December 1906, *Coker 23 p.p.*; also, Jan. 25, 1907, *Coker 32;* "dredged very close to the Island of San Lorenzo," region of Callao, Feb. 5, 1907,

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* *Dictyota Fasciola* was originally founded, in part at least, on *Fucus Fasciola* Roth and the name is currently written "*Dictyota Fasciola* (Roth) Lamour." But *Fucus Fasciola* Roth, as is somewhat manifest from Roth's figure and detailed description and as is shown by his original specimens, is what J. Agardh long afterwards described as *Dictyota repens* and later made the type of his new genus *Dilophus.* Under the prevailing rules of nomenclature the specific name *Fasciola* should replace *repens* and the legal name of the type of *Dilophus* becomes

Dilophus Fasciola (Roth) comb. nov.

Fucus Fasciola Roth, Cat. Bot. 1: 146. *pl. 7. f. 1.* 1797; 2: 160. 1800.

Dictyota Fasciola Lamour. Jour. de Bot. 2: 43. 1809. (At least as to the typical, name-bringing part.)

Dictyota repens J. Ag. Alg. Mar. Med. Adriat. 38. 1842; Kütz. Tab. Phyc. 9: 5, *pl. 9. f. 1.* 1859.

Dilophus repens J. Ag. Till Alg. Syst. 2: 106. 1880; Kjellm. in Engler & Prantl, Nat. Pflanzenfam. 1^2: 297. 1893; De-Toni, Syll. Alg. 3: 284. 1895.

Under the "American Code" the "*Dictyota Fasciola*" of recent authors requires a different specific name, though possibly no other is demanded under the "Vienna Rules," and the "Brussels Amendments." A name that satisfies all requirements is doubtless to be found for it among currently cited synonyms of "*Dictyota Fasciola*."

It may be remarked that the Roth herbarium, now preserved at the Grossherzogliches Naturhistorisches Museum in Oldenburg is, in general, in excellent condition. The algae are in Roth's original species-covers inscribed on the outside (first page) with name of class, genus, and species. The second page of the cover bears the generic and specific names, diagnosis, synonymy (if any), habitat, and date of collection or acquisition by Roth. In the case of *Fucus Fasciola*, the species is represented by several loose specimens in an attached pocket. The opposite (second) page of the cover is inscribed with the name, diagnosis, and "1794. Inter Fucum Helminthochorton legi."

Coker 56 (PLATE 28); in the surf, Island of San Lorenzo, Feb. 5, 1907, *Coker 57 p.p.*; on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 192 p.p.*; also, in same locality and habitat, July 13, 1908, *Coker 493 p.p.*; in one fathom, Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09640 p.p.*

Nos. 23, 32, 56, and 57 are from the type locality or near it. The specimens collected represent various ages and sizes of the plant, yet all of the mature ones, so far as we have examined them microscopically, appear to be tetrasporic. The largest plants collected attain a length of a little more than 30 cm. In the younger and middle-aged plants, a cross section of the thallus very commonly shows only a single layer of cells in the cortex, but in the older conditions the cortex consists of two and occasionally three layers, if one includes in the "cortex" a layer that often has a character somewhat intermediate between the surface layer and the medulla. We rarely find J. Agardh's "fila brevia verticalia" except in the basal parts. The tetrasporangia occur on both the main thallus and the outgrowths from its surface. In the best-developed condition (no. 23), both surfaces of the thallus, with the exception of basal portions and occasional margins, are very densely covered with ligulate or spatulate foliola, which are often dichotomous, proliferous, or subpinnately compound, and commonly bear more or less numerous root-hairs on their margins and ventral surfaces.

The original specimens were brought from Callao and "Guanchaco" by Humboldt. The species has since been reported from the region of Callao by Piccone (Alg. Vettor Pisani 33. 1886). Pilger (Hedwigia **48**: 178. 1908) attributes it to Chile also.

PLATE 28. *Glossophora Kunthii*

Photograph of a dried specimen (*Coker 56*), reduced to about two fifths of the natural dimensions.

Padina Durvillaei Bory, originally described from Concepcion, Chile, seems to occur also in northern Mexico (Bull. Torrey Club **38**: 497. 1911) and California (Farlow, Anderson, & Eaton, Alg. Exsicc. Am. Bor. *158*) and is likely to be found on the shores of Peru.

RHODOPHYCEAE

Family BANGIACEAE

PORPHYRA Ag. Syst. Alg. xxxii, 190. 1824

Diploderma Kjellm. Kongl. Sv. Vet. Akad. Handl. **20**[5]: 188. 1883.
Wildemania De-Toni, Nuov. Notar. **1**: 143. 1890.

PORPHYRA KUNTHIANA Kütz. Phyc. Gen. 383. 1843;
Tab. Phyc. **19**: 30. *pl. 84.* 1869

Pescadores Islands, Feb. 12, 1907, *Coker 80 p.p.*; "common on surf-washed rocks (this species is eaten)," Chincha Islands, July 13, 1908, *Coker 491;* from rocks in the surf, Mollendo, August, 1908, *Coker 565 p.p.*

Our specimens are rather small and are apparently more or less decolorate from the mode of preservation. The thalli are narrower than those of the type as figured by Kützing. They are clustered or in rosettes, linear-lanceolate or oblong-lanceolate, 6–10 cm. long and 1–2.5 cm. wide, undulate-crisped and often contorted. The thallus varies in thickness in different parts and different plants from 60 to 130 μ; it is monostromatic in the vegetative parts; the surface jelly is very thick, that of the two surfaces together often constituting one half or even three fifths of the thickness of the thallus. The plants are monoecious, the sporocarps and antheridia in irregular marginal patches; sterile cells, usually in groups, are often intermingled with the sporocarps, but not with the antheridia; small irregular islands of antheridia often occur among the sporocarps and sporocarps are occasionally found irregularly scattered among the vegetative cells. Spores 32 or the division is perhaps sometimes complete when 16 have been formed; antherozoids 128, or possibly 64 by imperfect division.

The type of *Porphyra Kunthiana*, collected at Valparaiso by Gaudichaud, we have been able to examine through the courtesy of Mme. A. Weber-van Bosse, the present owner of the Kützing herbarium. The thallus of the type specimen, when soaked out in water, has a thickness of 80–100 μ in incipiently reproductive parts and is here vegetatively monostromatic; the specimen is monoecious and shows the general characters of sporocarps and antheridia described above for Dr. Coker's specimens.

Porphyra perforata, described from California by J. Agardh in 1882, is evidently very closely allied to *P. Kunthiana* and may prove to be synonymous. However, we have not noted in *P. perforata* little islands of antheridia among the sporocarps, a character that may sometimes be observed in *P. Kunthiana;* the sterile cells intermingled with the sporocarps in *P. perforata* are commonly larger than the corresponding cells in *P. Kunthiana*.

Porphyra laciniata has been reported from the Island of San Lorenzo, near Callao, by Piccone (Alg. Vettor Pisani 51. 1886).

GONIOTRICHUM Kütz.* Linnaea **17**: 89. 1843; Phyc. Gen. 244. 1843

Diconia Harv. Man. Brit. Mar. Alg. 219. 1849 [ed. 2].

Goniotrichum Alsidii (Zanard.) comb. nov.

Bangia Alsidii Zanard. Bibl. Ital. **96**: 136. 1839; Syn. Alg. Mar. Adriat. 115. *pl. 6. f. 7.* 1841.

Bangia elegans Chauv. Alg. Norm. *no. 159* (without diagnosis); Mém. Soc. Linn. Norm. **6**: 13. 1838 (nomen nudum); Recherches 33. 1842. Harv. Phyc. Brit. *pl. 246.* 1846–51.

Goniotrichum elegans (Chauv.) Zanard. Not. Cell. Mar. 69. 1847. J. Ag. Till Alg. Syst. 3: 13. 1882. Rosenvinge, Kgl. Danske Vidensk. Selsk. Skrift. VII. **7**: 75. 1909.

Goniotrichum dichotomum Kütz. Tab. Phyc. 3: 7. *pl. 27. f. I.* 1853.

Goniotrichum ceramicola Kütz. loc. cit. *pl. 27. f. II.*

Porphyra elegans Crouan, Fl. Finist. 132. *pl. 10. f. 73.* 1867.

Goniotrichum elegans Alsidii Zanard. Mem. R. Ist. Ven. **17**: 457. *pl. 96A.* 1873.

On *Chaetomorpha*, *Cladophora*, etc., dredged in "2½ fathoms," Island of San Lorenzo, region of Callao, February 5, 1907, *Coker 59 p.p.* The plants are small, usually 150–350 μ long and never,

* The interpretation and application of Kützing's generic name *Goniotrichum* has been well discussed by J. Agardh (Till Alg. Syst. 3: 12, 14, 15). It seems to be a case in which one may be justified in ignoring the purported "type species" on the ground that this species was misinterpreted by Kützing and that he really had something quite different in mind. If, however, the generic name *Goniotrichum* is ever interpreted according to its alleged "type" and is thus made to supplant the later and more clearly defined *Erythrotrichia* Aresch., the oldest available name for what is now known as *Goniotrichum* would appear to be *Diconia* Harv.

so far as we have observed, more than 1 mm. long, are 15–35 μ in diameter, and simple or with 1–3 branches; the cells are varied in form, but are often short and disc-like as represented in Rosenvinge's *fig. 15B* (Kgl. Danske Vidensk. Selsk. Skrift. VII. 7: 76. 1909), but are even more often plano-convex, biconcave, or concavo-convex than there shown, the cells of these forms commonly alternating with rounder cells from which they have evidently been cut off in cell division; the cells are usually in a single series, but are occasionally in two series, and rarely in three or four irregular series, but the last-mentioned forms must be carefully discriminated from other Bangioid species (*Erythrotrichia polymorpha*, etc.) with which it grows associated. In their small size and few branches, the Peruvian plants are evidently closer to the original *Bangia Alsidii*, as described and figured by Zanardini, than to the original *Bangia elegans* of Chauvin. The Peruvian specimens in several respects suggest the Gulf of Naples plant that Berthold has proposed to keep distinct under the name *Goniotrichum dichotomum* Berthold * non Kützing, but we have never seen in them so many as eight cells in cross section and have never observed any approaching the transverse multiplication of cells figured by Reinsch (Contrib. Alg. et Fung. 40. *pl. 15*) for the fully developed condition of his *Stylonema Cornu-cervi*, of which Berthold's *Goniotrichum dichotomum* has been supposed to be a synonym.

GONIOTRICHUM CORNU-CERVI (Reinsch) Hauck, in Rabenh. Krypt.-Fl. 2: 519. 1885

Stylonema Cornu-cervi Reinsch, Contrib. Alg. et Fung. 40. *pl. 15*. 1875. (As *S.* "*Cornu Cervi*.")

On *Cladophora* and *Chaetomorpha*, with *Acrochaetium*, *Erythrotrichia polymorpha*, and other epiphytes, in beach drift, La Punta, region of Callao, January 25, 1907, *Coker 38 p.p.*

Plants reaching a height of 0.85 mm., mostly simple but often once forked and occasionally two or three times irregularly dichotomous, 20–65 μ in greatest width, soon 2 or 3 cells wide, the cells commonly in regular and often spaced longitudinal rows as if

* Die Bangiaceen des Golfes von Neapel und der angrenzenden Meeres-Abschnitte, 26. 1882.

representing coalesced branches, the cells later often irregularly arranged and the broader parts 3–6 cells wide and 2 or 3 cells thick, the base commonly remaining unicellular and the apices of a single series of cells; cells extremely varied in form, mostly 7–14 μ in maximum diameter. The plants appear to be quite distinct from those that we have referred to *G. Alsidii*, in form and structure and also in color, so far as the last-mentioned character may be determined from formalin-preserved specimens, the *G. Cornu-cervi* being apparently greener and darker. The outer gelatinous walls are much attacked and surrounded by bacteria in both old and young individuals, but this may have little significance, as other attendant epiphytes are attacked in a similar way, though in a less degree.

ERYTHROTRICHIA Aresch.; Fr. Summ. Veg. Scand. 132. 1846; Phyc. Scand. Mar. 209. 1850

Erythrotrichia polymorpha sp. nov.

The strongly developed basal disc suborbicular or oblong, attaining often a diameter of 150–600 μ, closely adherent or in age more or less free at the margins, the younger discs monostromatic throughout, the older becoming irregularly distromatic in the central portions and at length giving rise there to few or many erect filaments, these finally, in some cases at least, becoming ribbon-shaped fronds; marginal cells of disc at first cuneate and often emarginate or furcate, becoming mostly oblong or linear-oblong and 13–30 $\mu \times$ 5–8 μ, those of central portions irregularly quadrate, ovoid, or suborbicular in surface view, 8–16 μ in diameter, often vertically elongate, clavate, and 20–40 μ high; erect fronds, when well developed, at length narrowly linear from a long-pedicelled base, attaining a length of 0.25–1.3 mm. and a maximum width of 35–85 μ, tapering very gradually to the base and a little less gradually to the apex, finally 8 cells in width and mostly of a single layer of cells or now and then irregularly bistratose, the cells usually in rather regular transverse rows, the margins plane, entire or lightly undulate, the pedicel 8–18 μ broad, of 5–25 cells in a single series; cells of frond at first quadrate-oblong or discoid, finally ovoid and mostly 6–11 μ in vertical diameter; spores borne either upon the disc or upon the erect fronds, ovoid, 8–14 μ in greatest diameter. [PLATE 29.]

On *Chaetomorpha cartilaginea* and *Cladophora fascicularis*, collected on surf-washed rocks, Chincha Islands, June 18, 1907,

Coker 196 p.p. (type); in same locality, on *Lessonia nigrescens*, with *Acrochaetium polysporum*, *Coker 197 p.p.*; in same locality and habitat, on *Glossophora Kunthii*, July 13, 1908, *Coker 493 p.p.*; on *Glossophora Kunthii* in beach drift, La Punta, region of Callao, December 1906, *Coker 23 p.p.*; on *Glossophora Kunthii*, "in the surf," Island of San Lorenzo, region of Callao, Feb. 5, 1907, *Coker 57 p.p.*; on *Spatoglossum crispatum*, Islands of Lobos de Afuera, Mar. 27, 1907, *Coker 145 p.p.*

The plants brought together in the above description and citations include a wide range of forms yet represent, we believe, conditions of growth and development of a single species. In the specimens on *Chaetomorpha* and *Cladophora* the disc or horizontal thallus has a remarkable development (FIGURES 8–10) and may produce spores whether erect filaments are present or not. These thalli in many places almost wholly cover the surface of their hosts, accompanied here and there by *Dermocarpa*, *Chlorogloea*, and other epiphytes. The erect filaments in these cases are of rather rare occurrence, are only 50–250 μ long and usually consist of a single row of cells (FIGURES 8 and 11), though filaments four cells in greatest width (FIGURE 12) also occur; in no case on these two hosts have spores been observed in the erect filaments. In the specimens epiphytic on *Glossophora* and *Lessonia*, the disc, while of the same general character, has a less luxuriant development and the erect filaments attain larger dimensions, becoming finally 850 μ long and 2, 4, and occasionally 8 cells in greatest width (FIGURES 13 and 14) and in the size and structure of the filaments these specimens show an apparently perfect series of gradations between the short simple ones of the *Chaetomorpha* and the more luxuriant ones just described. In these specimens on *Glossophora* and *Lessonia* we have observed no spores, either in the disc or in the filaments. The specimens on *Spatoglossum* are much crowded by other epiphytes (*Acrochaetium*, *Streblonema*, etc.) and the disc has no such wide extension as on *Chaetomorpha* and *Cladophora*, but the erect portions have the best development that we have noted for the species, becoming as much as 1.3 mm. long and often 8 cells wide, though the younger of these filaments appear to be identical in character with the simple ones that spring from the large discs on the *Chaetomorpha* and *Cladophora*.

In the *Spatoglossum* material we have observed no spores on the discs, but they are abundant in erect fronds after they reach a width of eight cells. These spores are, however, a little smaller than those that occur on the discs of the *Chaetomorpha*, having a diameter of 8–11 μ, while those of the *Chaetomorpha* have a diameter of 11–14 μ.

Erythrotrichia polymorpha is evidently allied to the imperfectly known *Erythrotrichia ciliaris* (Carm.),* originally described from Scotland, yet we have felt unwilling, for the present, to dispose of it as a variety or form of that species. For our knowledge of *E. ciliaris* we are indebted chiefly to Batters' description (loc. cit.) of Carmichael's original plant now preserved at Kew and to his identifying with it a specimen collected at Arbroath, Scotland, by E. M. Holmes. The British plant appears to have a greater development of the erect filaments and usually a less development of the basal disc than is the case in the Peruvian; its disc is more pulvinate, sometimes almost hemispherical, and the disc-margins are less long-celled and repent; the broader parts of the erect filaments or fronds (in the Arbroath plant on *Corallina*, at least) have irregular, jagged, subdentate, or sinuate-undulate margins, and in these parts the cells are more angular and average to have about twice the diameter of the corresponding cells in the Peruvian plant; the spores have been observed on the "fronds" only and are said by Batters to have a diameter of 18 μ, which is about twice the average diameter of the "frond" spores of *E. polymorpha*.

The fact that the disc alone of *Erythrotrichia polymorpha* is commonly all that is present on *Chaetomorpha* and *Cladophora* naturally suggests at once a relationship with the plant of the Bay of Naples described and figured by Berthold † as *Erythrotrichia discigera*, especially as Berthold remarks that discs alone were observed by him on *Chaetomorpha* and *Cladophora* species (loc. cit. 4) and that cultivated discs of *E. discigera* produced spores (loc. cit. 19). However, from Berthold's description and figures, one would hardly be justified in identifying the Mediterranean plant with

* *Erythrotrichia ciliaris* (Carm.) Thuret, p.p. in Le Jolis, Liste Alg. Mar. Cherbourg 103. 1863; Batters, Jour. Bot. 38: 374. 1900.

Bangia ciliaris Carm.; Hook. Brit. Fl. 2: 316. 1833.

† Mitth. Zool. Stat. Neapel 3: 511. 1882; Bang. Golf. Neapel 4, 25. *pl. 1. f. 15–18.* 1882.

the Peruvian. His description of the erect filaments attributed to this species is so brief and his two figures of these filaments so incomplete that one can infer little as to their form and structure, and his two figures of the discs, even with some allowances for evidently diagrammatic drawing, hardly suggest the discs of the Peruvian plant. Professor Berthold writes us that he has only microscopic preparations of his Bangiaceae of the Bay of Naples and we have thus far been unable to obtain from Naples or elsewhere authentic material for comparisons. Schmitz, in proposing the new generic name *Erythropeltis** for *Erythrotrichia discigera* Berthold (which he cites as the monotype of his new genus without any *pro parte* reservations), omits any reference to the erect filaments described and figured by Berthold. Batters (loc. cit.) in discussing this point has expressed the opinion that *Erythropeltis discigera* Berthold is without doubt the true *Bangia ciliaris* Carm. and that Schmitz had before him a different plant that is permanently discoid and produces no vertical filaments. Yet Berthold, who studied the plants in the field, believed (loc. cit. 4) that his species might take the form of large discs without erect filaments or of smaller discs with numerous and manifest erect filaments and our own experience in studying Dr. Coker's plants convinces us that this Peruvian species, though doubtfully identical, exhibits a similar and probably parallel polymorphism. We are indebted to Mr. A. Gepp of the British Museum for the information that the only preparation in the Schmitz collection that seems to have anything to do with "*Erythropeltis*" bears the label, "*Erythrotrichia discigera* Berth. Berthold ded. 10/9/79" and that this specimen appears to show no erect filaments.

The erect filaments in *Erythrotrichia polymorpha* often resemble closely Kützing's figures† of his *Porphyra bangiaeformis* originally described as growing on *Chondrus crispus* near Biarritz, but Kützing shows no basal disc and makes no mention of such a disc in his description. The type material of this *Porphyra bangiaeformis* in the Kützing herbarium consists of a few detached plants or fragments on mica, showing little or nothing as to the nature of the basal disc, although the cespitose habit of the

* In Engler & Prantl, Nat. Pflanzenfam. 1²: 313. *f. 195.* 1896.

† Tab. Phyc. **19**: *pl. 79. f. a–d.*

filaments suggests that a disc is really a part of the plant. J. Agardh apparently considered *Porphyra bangiaeformis* a synonym of *Bangia ciliaris* and this opinion has been adopted by De-Toni in his "Sylloge Algarum."

Erythrotrichia polymorpha, like *E. ciliaris* and *E. discigera*, differs markedly from the type species of *Erythrotrichia* in the presence of a basal disc and if this character is ever considered of generic importance, the name *Erythropeltis* will doubtless be available for this generic group, but species with and without basal discs are still considered congeneric in *Acrochaetium* (*Chantransia*) and it is quite conceivable that forms of *Erythrotrichia* will be discovered that would make the suggested generic segregation seem forced and arbitrary.

PLATE 29. *Erythrotrichia polymorpha*

1–7. Early stages in the development of the basal disc, beginning with the one-celled spore, on *Chaetomorpha*.
8. A well-developed basal disc on *Chaetomorpha*, with erect filaments (cells uniseriate) springing from its center. The disc produces spores in various parts, as at *sp*.
9. A sector of a well-developed disc, becoming irregularly distromatic in central parts. The cell divisions are mostly vegetative but spores occur.
10. A portion of the margin of a disc on *Cladophora*. Spores are shown at *sp*.
11. Erect filaments (cells uniseriate) and margin of basal disc (in optical section), on *Cladophora*.
12. An erect filament with cells irregularly 4-seriate above, on *Cladophora*.
13. An erect filament with cells 2-seriate above, on *Glossophora*.
14. An erect filament with cells 4-seriate above, on *Lessonia*.
15. Spores and accompanying sterile cells from the filament-bearing basal disc shown in Fig. 8.
16. Spores, etc., from a disc that bears no filaments—also on *Chaetomorpha*.
17. Portion of a spore-bearing erect filament with cells 8-seriate above, on *Spatoglossum*.

Figures 1–12, 15, and 16 are drawn from the type material (Chincha Islands, *Coker 196 p.p.*); 13, from *Coker 493 p.p.* (Chincha Islands); 14, from *Coker 197 p.p.* (Chincha Islands); 17, from *Coker 145 p.p.* (Islands of Lobos de Afuera). Figures 1–7, 9–13, and 15–17 are enlarged 345 diameters; 8, 66 diameters; 14, 232 diameters.

ERYTHROCLADIA Rosenv. Kgl. Danske Vidensk. Selsk. Skrift. VII. 7: 71. 1909

Erythrocladia endophloea sp. nov.

Endophytic or pseudo-epiphytic, creeping in the superficial cell walls of other algae; thallus minute, consisting at first of straggling irregularly radiating filaments, becoming at length

suborbicular or suborbicular-pulvinate and pseudoparenchymatous, the discs attaining a diameter of 180 μ, mostly monostromatic, but often irregularly 2–4-stratose in the commonly elevated and sometimes bullate central portion; ramification lateral or subdichotomous, occurring mostly in subterminal cells; cells in surface view ovoid, suborbicular, oblong, pyriform, deltoid, rhomboid, cuneate, or lunate, 4–14 μ in maximum diameter, those of the mature disc, except the marginal, commonly elongate vertically and appearing ovoid, rhomboid, or subclavate in a vertical section; spores 4–5 μ in diameter. [PLATE 30, FIGURES 1–7.]

Growing in the outer rather firmly gelatinous walls of *Leptocladia peruviana*, "dredged in five fathoms," in the Bay of Sechura, *Coker 157 p.p.* It is commonly associated with *Hyella infestans* and *Chlorogloea endophytica* and is sometimes more or less intermingled with them. Well-developed thalli bear some superficial resemblance to the young nemathecia of the host plant, but may be distinguished by their darker color, repent margins, etc.

Erythrocladia irregularis Rosenv. and possibly also *E. subintegra* Rosenv. (loc. cit. 72–75. *f. 11–14*), authentic specimens of which, on *Polysiphonia urceolata*, we owe to the kindness of Dr. Rosenvinge, appear to us to be ordinarily immersed in the walls of their host and to be endophytic rather than epiphytic. However, it would, we think, be wrong to attempt to identify *E. endophloea* with either of them. The younger stages bear some resemblance to *E. irregularis*, but the older are more like *E. subintegra*, differing, however, in the relatively less elongate form of the cells in the surface view, in the absence of dichotomy in the marginal cells, in the finally convex and often irregularly 2–4-stratose character of the older portions of the thallus, etc. The cell walls of the *Erythrocladia* are so blended with those of its host that they are scarcely visible as a rule and our measurements and most of our figures are drawn from the protoplasts alone.

Erythrocladia endophloea is primarily and essentially an endophyte, but is often, especially in its thicker central parts, so close to the surface of its host that it may present superficially much the habit of an epiphyte.

Rosenvinge, in establishing the genus *Erythrocladia* (loc. cit. 71), discusses its possible relationship to the endophytic *Colaco-*

nema Batters, but, apparently, without seeing authentic specimens of the latter. *Colaconema Bonnemaisoniae*, the type species of *Colaconema*, seems, however, to be not uncommon in herbarium specimens of *Bonnemaisonia asparagoides* and is, we judge, a close relative of *Acrochaetium*, near which it was finally placed by Batters. The relationship of *Erythrocladia* to *Erythropeltis* Schmitz, which also is disscused by Rosenvinge, is doubtless deserving of consideration, but, as Rosenvinge intimates, cannot be well determined until *Erythropeltis* is better understood than it is at present. Batters,* who had seen the type of *Bangia ciliaris* Carm., but not the type of *Erythrotrichia discigera* Berthold, which, in turn, must be considered the type of *Erythropeltis* Schmitz, has hinted strongly that Berthold's name may prove to be a synonym of Carmichael's *Bangia ciliaris*.

PLATE 30, FIGURES 1–7. *Erythrocladia endophloea*

1. About one quarter of a large mature thallus seen from above, with most of the protoplasts indicated in outline only (the walls of the cells are hardly visible under ordinary conditions); spores are beginning to be formed near the center of the thallus.
2, 3. Sections of the thallus of host plant, showing the *Erythrocladia* imbedded in the outer gelatinous walls of the cortical cells of the host.
4. A young thallus seen from above, with outlines of protoplasts of the cortical cells of the host indicated by dotted lines.
5. Young thalli—apparently four or five of independent origin (or possibly from a single spore with the connecting cells obscure or absent).
6. Spores, etc., in surface view.
7. A section of the cortex of the host plant, showing a spore of the *Erythrocladia* penetrating the outer walls of the cortical cells.

Family NEMALIONACEAE†

ACROCHAETIUM Naeg. Sitzungsb. Königl. Bay. Akad. Wiss. München 1861²: 402. 1861. J. Ag. Anal. Alg. 45. 1892

Chantransia Thuret,‡ in Le Jolis, Mém. Soc. Imp. Sci. Nat.

* Jour. Bot. 38: 374, 375. 1900.

† The family name "Helminthocladiaceae," being formed from a generic name originally applied to the type of *Mesogloia*, is, in its current sense, invalid under the "American Code."

‡ The generic name "*Chantransia*" has been used in so many different senses that it easily lends itself to confusion and ambiguity, but its use in the sense now commonly current (for *Acrochaetium*) is so clearly in violation of all of the codes of nomenclature that it will doubtless soon be permanently relegated to synonymy. Such a course will be rendered easier by the fact that *Acrochaetium*, the older name of

Cherbourg **10**: 70. 1863; Schmitz, Flora **72**: 438. 1889. Not *Chantransia* DC. Fl. Fr. **2**: 49. 1815. Not *Chantransia* Fr. Syst. Orb. Veg. 338. 1825 (at least, as to the specified types).

Acrochaetium catenulatum sp. nov.

Epiphytic, minute, mostly 50–150 μ high; the single basal cell (spore) subglobose, 8–11 μ in diameter; the single main axis suberect or ascending, 9–11 μ in diameter, usually 10–20 cells long, commonly arcuate and with a secund series of mostly simple and often successively shorter branches along the convex side, the branches beginning with the basal cell or often several cells higher, now and then irregularly alternate or very rarely opposite, ultimate ramuli 7–8 μ in diameter; cells mostly as long as broad, often a little less long than broad, rarely twice as long, usually quadrate-orbicular in optical section, now and then discoid and occasionally biconcave or concavo-convex, the cell wall rather thick and gelatinous especially in basal and median parts, mostly 1–2 μ thick; chromatophore (?) apparently occupying nearly the whole cell except for a few small irregularly disposed vacuoles; hairs apparently wanting; monosporangia 9–11 μ long, 5.5–7.0 μ wide, thinner-walled than the vegetative cells, finally terminating the main axis and most of the branches and commonly also sessile and secund along the outer (convex) face of the arcuate-hamate upper half of the main axis, the emptied sporangia sometimes refilled by the subjacent cells, two (rarely three) successive terminal cells of axis or branch often converted into sporangia simultaneously. [PLATE 31, FIGURES 12–18.]

On *Chaetomorpha cartilaginea* in beach drift, La Punta, region of Callao, January 25, 1907, *Coker 38 p.p.*, associated with *Acrochaetium clandestinum*, *Goniotrichum Cornu-cervi*, *G. Alsidii*, *Pleonosporium venustissimum*, *Erythrotrichia polymorpha*, *Ectocarpus* sp., etc. The short often flattened-globoid or even occasionally discoid cells, combined with the rather thick gelatinous walls, give young unbranched plants (see FIGURE 14) some superficial resemblance to young conditions of *Goniotrichum Alsidii*, with which they are sometimes associated, but the filaments of the *Acrochaetium* have a less diameter and their walls are thinner. The cell contents are very homogeneous and the coloring matter

the genus, has met with more or less acceptance since it was revived by J. Agardh in 1892. The Danish species of the group have recently been monographed in a very careful and masterly fashion by Dr. L. Kolderup Rosenvinge (Kgl. Danske Vidensk. Selsk. Skrift. VII. **7**: 80–144. *f. 18–67.* 1909).

appears in our formalin-preserved material to be generally diffused, except for minute vacuoles, while in the accompanying *Acrochaetium clandestinum* the chromatophores have more or less definite forms as described and figured under that species. We find no trace of a pyrenoid in the vegetative cells, but in the spores there is a denser central body that sometimes shows a starch reaction with iodine.

Acrochaetium catenulatum is evidently related to the West Indian *Chantransia crassipes* Börg. (Bot. Tidssk. 30: 1. *f. 1.* 1909) and the Danish *Chantransia moniliformis* Rosenv. (Kgl. Danske Vidensk. Selsk. Skrift. VII. 7: 99. *f. 28, 29.* 1909). Its affinity with *C. crassipes* is perhaps particularly close, but it appears to differ in being a larger plant, in having cells 7–11 μ broad instead of 4–7 μ, in having a basal cell that in the mature condition of the plant is not especially different from the other cells of the main axis and is often a little smaller than they rather than larger, in the absence of hairs, in the conspicuous hamate curving of the main axis of the larger fertile plants, in the terminal as well as lateral sporangia, in the occasional simultaneous formation of sporangia by two or three concatenate cells, etc. The basal cell, it may be remarked, is, in most cases, partially immersed in the wall of its host. It is at first larger and more refringent as to its contents than the other cells of the young filament, but eventually is scarcely different from the adjacent cells.

From *Chantransia moniliformis* Rosenv., the Peruvian plant differs in having one recognizable erect main axis instead of two or more, in the relatively shorter cells of the adult condition, in the absence of hairs, in the smaller, terminal as well as lateral, and occasionally concatenate sporangia, in the apparently different chromatophore, etc. Many young plants of *Acrochaetium catenulatum* have been examined without finding any trace of hairs. The apices, however, as shown in some of our figures, often bear the remains of the walls of evacuated sporangia.

PLATE 31, FIGURES 12–18. *Acrochaetium catenulatum*

12. A single plant, showing mode of branching, form of the cells and chromatophores, one emptied and three filled monosporangia, etc.
13. A portion of another plant, showing three two-celled lateral branches in each of which the terminal cell becomes a monosporangium and in two of which the other cell also becomes a monosporangium simultaneously.

14. A young unbranched plant with a terminal monosporangium.
15, 16. Plants with short secund branches and hamate-arcuate axes. The monosporangia are here secund and sessile or terminate the short branches.
17. A plant with alternate, opposite, and irregular branching.
18. A plant with secund branches, of which the lower are longer than the main axis (here shown in a horizontal position).

All figures from plants on *Chaetomorpha* (La Punta, region of Callao, *Coker 38 p.p.*). Figures 12 and 13 are enlarged 675 diameters; 14–18, 390 diameters.

Acrochaetium clandestinum (Mont.) comb. nov.

Callithamnion clandestinum Mont. Ann. Sci. Nat. Bot. II. **8**: 350. 1837; Fl. Boliv. 15. *pl. 7. f. 2.* 1839.

Epiphytic, with a well-developed multicellular unistratose basal disc of more or less coherent creeping filaments; erect filaments rather loosely cespitose, penicillate, or pulvinate, 0.5–1.2 mm. high, broadest near the middle, tapering towards the base and very slightly towards apex, 5.5–8.0 μ in diameter near base, 8–11 μ in middle and about 8 μ at apex, sparingly branched in the lower half, rather freely branched and often fasciculately decompound in the upper half, the branches secund, irregularly alternate, or occasionally opposite, the ultimate ramuli 5–8 μ in diameter; cells mostly 3–6 times as long as broad, becoming 2–3 times in the ramuli and at the apices; chromatophore single, parietal, often deeply lobed, or sometimes apparently divided into two or more separate parts, occasionally somewhat ribbon-shaped, pyrenoid lateral or very commonly at one end of the cell; hairs apparently wanting; monosporangia 8–11 μ long, 4.5–5.5 μ wide, thin-walled, rather diaphanous and inconspicuous, mostly in pairs or solitary at the apices of one- or two-celled, usually secund, often irregularly alternate, or rarely opposite ramuli, occasionally sessile or terminal on the main branches, the basal cell of the two-celled fertile ramuli commonly bearing a latero-terminal sporangium, the sporangia all smaller than the supporting cells. [PLATE 31, FIGURES 19–24.]

On *Chaetomorpha* and *Cladophora fascicularis* in beach drift, La Punta, region of Callao, January 25, 1907, *Coker 38 p.p.*, associated with various other epiphytes, as indicated under *Acrochaetium catenulatum*.

The original specimens of Montagne's *Callithamnion clandestinum* (on *Cladophora fascicularis*, Callao, *d'Orbigny*) we have been enabled to see through the obliging kindness of the curators of the herbarium of the Muséum d'Histoire Naturelle of Paris. The material, which is fastened to two small pieces of mica, is meager and we have not felt justified in attempting to remove any

of it for a very minute examination, but its general microscopic appearance, taken in connection with Montagne's description and figures, leaves us in no real doubt that it is specifically identical with the plant now described and figured from the same locality and in part on the same host. The only essential fault in Montagne's description would appear to be in an exaggerated idea as to the length of the plant as expressed in "Fila 2 lineas ad semipollicem longa." Montagne's specimens, so far as preserved, are, like Coker's, scarcely more than 1 mm. long. However, in Montagne's first description the only reference to size is "microscopique." Montagne seems to have recognized the true affinities of the plant by associating with it in his herbarium a specimen of *Callithamnion Savianum* Menegh. on leaves of *Zostera* from Genoa, sent to him by Meneghini.

Among the more recently and more critically described species, the nearest relative of *Acrochaetium clandestinum* is probably *Chantransia attenuata* Rosenv. (Kgl. Danske Vidensk. Selsk. Skrift. VII. 7: 106. *f. 35*. 1909), found growing on *Desmarestia aculeata* in one of the sounds of Denmark, but according to Rosenvinge's description and figures of this species, the Peruvian plant is taller, somewhat coarser, and more copiously branched, its branches are longer, its main filaments diminish in size towards the base rather than towards the apex, its cells are longer, its sporangia are smaller instead of larger than the supporting sterile cells, and the plant is apparently destitute of hairs.

Of the Barbados *Acrochaetium flexuosum* Vickers (Ann. Sci. Nat. Bot. IX. 1: 60. 1905) as distributed by Miss Vickers (Alg. Barbad. *98*), we have seen only imperfect specimens, but have better ones of what we suppose to be the same species on the same host (*Chaetomorpha media*—"*C. antennina*") from Porto Rico. In these the cells are much shorter than in the Peruvian plant, being rarely 3 times as long as broad (often 6 times in the Peruvian) and the chromatophore is usually more or less H-shaped in optical section with a large bulge from one side towards the center of the cell—quite different from the chromatophore of *A. clandestinum*. The West Indian plant forms larger more densely pulvinate masses and usually has numerous decumbent filaments somewhat intermediate in character between those of the disc and those that

are truly erect. Its sporangia are larger than those of *A. clandestinum* and are commonly larger than the supporting cells.

PLATE 31, FIGURES 19–24. *Acrochaetium clandestinum*

19. A part of a basal disc with young erect filaments.
20. Apical portion of a main branch of a mature erect filament, showing secund ultimate ramuli, monosporangia, chromatophores, etc.
21. A portion of a main axis, showing opposite branching, thin-walled monosporangia, lobed or divided chromatophores, position of pyrenoid, etc.
22. A rather unusually elongate monosporangium with a one-celled pedicel.
23. A portion of main axis, showing form of cells and chromatophores, position of the pyrenoid, empty sporangia, etc.
24. A cell from the main axis, with chromatophore lobed in a more or less ribbon-shaped fashion and the pyrenoid near the upper end.

All figures from plants on *Chaetomorpha* (La Punta, region of Callao, *Coker 38 p.p.*). Figures 19 and 20 are enlarged 390 diameters; 21–24, 675 diameters.

Acrochaetium polysporum sp. nov.

Basal disc well developed, monostromatic, suborbicular, mostly 150–850 μ in diameter, closely adherent to the substratum, at first parenchymatous, later often irregularly filamentous at the margin, nearly all of the cells finally producing erect filaments; cells of the disc 5.5–8.0 μ broad, 1–2 times as long; erect filaments very numerous, finally 300–500 μ (20–40 cells) long, with few or many of the intermingled and marginal remaining 25–80 μ (2–6 cells) long, all simple or in very rare cases, with a single vegetative branch, the cells cylindric or slightly tumid, 11–22 μ × 8–11 μ, 1–3 times as long as wide; chromatophore parietal, usually more or less 2-lobed proximally and distally, often (especially before cell division) so deeply lobed as to appear H-shaped, or merely unilaterally cleft or irregularly and sparingly cribose, pyrenoid usually a little eccentric; sporangia ovoid, 16–24 μ × 8.5–12 μ, polysporous, containing usually 8–16 (–32?) spores, lateral or terminal, mostly in a secund lateral series of 3–20, very rarely opposite, sessile or with a unicellular pedicel, nearly every cell of the erect filament sometimes giving rise to a sporangium, commonly also terminal on the short and less commonly on the longer filaments, cells of the main filaments occasionally converted directly into sporangia and then becoming more or less unilaterally gibbous or protuberant, the lateral and terminal sporangia often regenerated from below. [PLATE 31, FIGURES 1–11.]

Growing on the laminae of *Lessonia nigrescens*, Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 09150 p.p.* (type); Chincha Islands, *Coker 197 p.p.*; also, rather poorly developed, on the leaves of *Macrocystis integrifolia*, Chincha Islands, *Coker 09614*

p.p. So far as we are aware, polysporic sporangia have not heretofore been attributed to *Acrochaetium* or *Chantransia* and their manifest existence in the present species (the material is preserved with formalin) might be considered by some to be sufficient ground for making it the type of a new and separate genus, but so long as monosporangia and tetrasporangia are not considered incongruous in a single generic group (*Acrochaetium* or *Chantransia*), there seems to be no compelling reason for refusing to admit polysporangia; in its other characters, so far as the material at hand affords grounds for judging, the plant is clearly a member of the group which includes *Chantransia virgatula secundata* (Lyngb.) Rosenv., *Chantransia Macula* Rosenv., and *Acrochaetium flexuosum* Vickers, even though amply distinct from any of these. The polyspores are, as a rule, discharged in a single mass and often adhere more or less and the young thalli are commonly multicellular from the first. Occasional cells of the older discs occur empty and we have found some grounds for suspecting that cells of the prostrate discs may here and there be converted into sporangia, but the evidence on this point is not conclusive. The erect filaments are nearly always simple, except for the often pedicelled lateral sporangia. In only three or four cases out of hundreds examined have we discovered a vegetative branch and in no case more than one such.

PLATE 31, FIGURES 1–11. *Acrochaetium polysporum.*

1. A portion of a typical basal disc.
2. A portion of the margin of another basal disc.
3. A portion of a more irregularly filamentous margin, showing chromatophores, etc,
4. A typical erect filament, with secund sporangia, some sessile and others with a one-celled pedicel. The lower emptied sporangia are being refilled from below.
5. Another erect filament, showing a single elongate branch (of very rare occurrence) terminated by a young sporangium. The main axis, also, is terminated by a sporangium; two of the lateral sporangia are opposite; the others are secund. with a change from one side to the other.
6. A cell from an erect filament, showing chromatophore and pyrenoid.
7. Short erect filaments with terminal sporangia, the empty ones being regenerated from below.
8. Two lateral sporangia, showing polyspores, etc. The sporangium wall is ruptured at apex.
9. Apex of an erect filament showing three cells of the main axis that have been converted directly into sporangia, with one sterile cell intervening.
10. Three concatenate sporangia of the main axis, in various stages of development.
11. Regeneration of two emptied lateral sporangia, one sessile, the other with a unicellular pedicel.

All of the figures are drawn from the type material on the laminae of *Lessonia nigrescens* (Pescadores Islands, region of Ancon, *Coker 09150 p.p.*). Figures 1, 4, and 5 are enlarged 232 diameters; 2, 3, 7, and 11, 390 diameters; 6, 8–10, 675 diameters.

The genus *Acrochaetium* is represented also in Dr. Coker's Peruvian material by the following specimens that we consider too meager or immature for determination:

On decaying thallus of *Spatoglossum crispatum*, with *Streblonema Cokeri*, *Erythrotrichia polymorpha*, etc., Islands of Lobos de Afuera, Mar. 27, 1907, *Coker 145 p.p.* Sterile, the sparingly branched filaments 6–8 μ in diameter, from a well-developed, often convex-arched, horizontal disc.

On *Chaetomorpha cartilaginea*, with *Goniotrichum* and various other epiphytes, San Lorenzo, region of Callao, Feb. 5, 1907, *Coker 59 p.p.* Filaments about 6 μ in diameter, with irregular or secund branches; basal disc well developed; sporangia ellipsoid, 13–15 μ × 7–9 μ, on a one-celled pedicel or terminal on a short branch, undivided or with a transverse septum, perhaps immature.

Of doubtful position, but possibly belonging with this family:

LOBOCOLAX gen. nov.

Thallus parasitic (in *Prionitis*), vegetating in cortex and medulla of the host plant and forming external hemispheric, subglobose, or difform sporiferous cushions, these becoming lobed, convolute, or somewhat cerebriform. Foot (intramatrical part) penetrating deeply, often lobulate, composed of rather compact irregularly interwoven filaments. Medulla consisting of intricate, freely anastomosing filaments and occasional larger irregularly branched cells, becoming loose and often hollow or filled with a tenuous jelly, the outer walls of the medullary cells soft-gelatinous and more or less confluent. Cortex consisting at first of long compact radio-vertical di–trichotomous occasionally anastomosing filaments, surmounted externally by a thick cuticle consisting of the distally much prolonged and laminated outer walls of the superficial cells, the cuticle soon exfoliating, or persisting at the base and in the sinuses, the cortical filaments, after the disappearance of the thickened cuticle, becoming more or less divergent, intricate, and often (especially in antheridial plants) showing somewhat fasciculate erecto-patent branchlets near their apices. Procarps*

* Only a few of the supposed procarps and cystocarps have been observed. They do not seem to conform in all respects to any of the types of these organs previously described and it is possible that we are mistaken in our interpretation of the phenomena now described and figured.

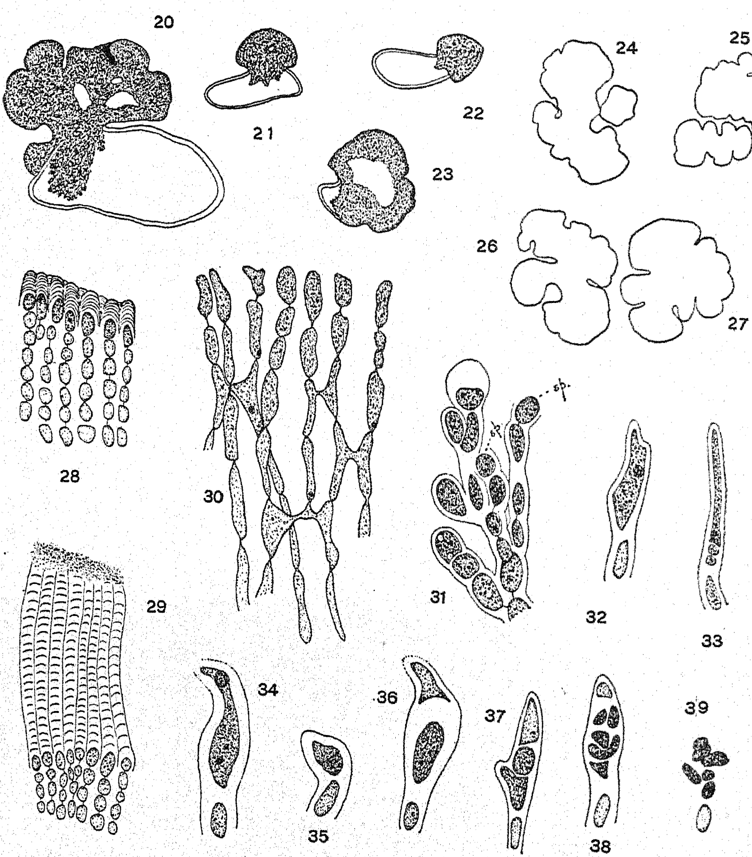
simple, 1-celled, terminating filaments of cortex; carpogonia fusiform, filiform, or lageniform, the trichogynes filiform or often short and irregular. Auxiliary cells wanting. Cystocarps few (2–10)-spored, the spores enclosed within the slightly modified carpogonium wall or the cystocarps occasionally showing one or more very short one- or two-celled branches; an apical cell, occupying position of the former trichogyne, apparently remaining sterile. Dioecious (or sometimes monoecious ?). Antheridia consisting of single cells terminating short branchlets of the cortical filaments. Sporangia unknown.

Lobocolax deformans sp. nov.

Characters of the genus. Cushions wart-like, 1–8 mm. broad, 1–4 mm. high, sessile, attached by a base usually ½–¼ as broad; cortex 100–350 μ thick; cells (protoplasts) of cortical filaments mostly 3–19 $\mu \times$ 2–5 μ; cuticle becoming 8–65 μ thick before exfoliation. [PLATE 32, FIGURE *A* and TEXT FIGURES 20–39; see also PLATES 64 and 65.]

On and in *Prionitis decipiens* (Mont.) J. Ag., Lobos de Afuera, Mar. 27, 1907, *Coker 144 p.p.* (type,—PLATE 65); Chincha Islands, June 18, 1907, *Coker 191 p.p.*; also, same locality and date, *Coker 193 p.p.* and *194 p.p.*; Chincha Islands, July 13, 1908, *Coker 492 p.p.* (PLATE 32, FIGURE *A;* PLATE 64).

The simple or reduced cystocarps and the mode of occurrence of the antheridia suggest placing *Lobocolax* with the Nemalionaceae (Helminthocladiaceae), though the vegetative structure, including the frequent anastomoses of the cells, both of medulla and cortex, is somewhat suggestive of the Gigartinaceae. The anticlinal corticating filaments also resemble in a way those of its host, but the cell walls in the parasite are less rigid, the cells themselves are more vacuous, and they anastomose more freely. Superficially *Lobocolax* bears more or less resemblance to *Actinococcus*, but it differs much in vegetative structure and there is, we believe, no possibility that it represents a sexual condition of *Actinococcus*. As compared with *Actinococcus*, the medulla of *Lobocolax* occupies a relatively very much larger proportion of the external thallus and it consists of more obvious, more vacuous, and more loosely interwoven filaments; the cortical filaments anastomose and cohere and do not separate and curl up when a section is placed in water as happens with *Actinococcus*, and, with the exception of



FIGURES 20–39. *Lobocolax deformans.* 20–23, sections, showing relations of parasite and host; 24–27, outlines of sections of the *Lobocolax* taken in planes more or less parallel to the surface of its host (24 and 25 are from the same thallus at different levels); 28, radio-vertical sections through cortex, showing laminated outer walls of the surface cells; 29, a similar section through an older part, showing the more thickened laminated walls, here 9–15 times as thick as the long diameter of the subjacent protoplasts; 30, a more enlarged view of the cortical filaments of a cystocarpic plant after the fall of the cuticle (the cell walls are so gelatinous, confluent, and inconspicuous that no attempt is made to indicate their outer boundaries; 31, the distal part of a cortical filament of an antheridial plant, the sperm cells shown at *sp.*; 32 and 33, supposed young procarps; 34, a carpogonium showing a supposed sperm nucleus in the trichogyne; 35 and 36, fertilized carpogonia (the apical cell apparently does not become a carpospore); 37, a fertilized carpogonium showing the beginning of a short branch; 38, a cystocarp without branching; 39, a cystocarp with rudimentary branching. Figures 20–22, 29–39 are drawn from the type material (*Coker 144 p.p.*); 23 and 28, from *Coker 193 p.p.*; 24–27, from *Coker 191 p.p.* Figures 20–27 are enlarged 5 diameters; 28, 29, 32–39, 405 diameters; 30 and 31, 780 diameters.

the younger parts and the bases and sinuses, where the cuticle persists, they have not the distinctly radio-parallel arrangement that is characteristic of *Actinococcus*. From the species of *Sterrocolax*, it differs, perhaps, even more widely.

Certain cells, sometimes uniseptate, detached from the ends of the corticating filaments we have sometimes suspected to be non-sexual propagative bodies, but they seem to be of irregular and infrequent occurrence and may be nothing more than accidentally detached parts of exposed branchlets.

Our *Lobocolax* is evidently what Montagne means by the "verrucae crassis sparsis (an statu morboso productis?)" of his original description of its host, *Prionitis decipiens*.

Cushions superficially somewhat similar to those of *Lobocolax* but smaller and less lobed occur on Peruvian specimens of *Ahnfeltia Durvillaei*, under which species some further mention of them is made.

PLATE 32, FIGURE *A*. *Lobocolax deformans*

Photograph, natural size, of thalli as shown by Coker's no. 492 p.p. (from liquid preservative).

Family CHAETANGIACEAE

Scinaia furcellata undulata (Mont.) J. Ag. (Sp. Alg. **2**: 422. 1852. *Ginnania undulata* Mont. Voy. Bonite, Bot. Crypt. 59. *pl. 145. f. 3.* 1844) was originally described from specimens from the shores of Chile and from Cobija, once in Peru, but now in Chile. It apparently occurs on the western coast of Mexico and in California and may be expected on the Peruvian shores.

Chaetangium variolosum (Mont.) J. Ag. (Sp. Alg. **2**: 461. 1852), originally described from the Auckland Islands (Voy. Pole Sud, Bot. **1**: 109. *pl. 10. f. 3*), was considered by Montagne (Syll. Crypt. 431. 1856) to include the plant from Cobija (once in Peru, now in Chile) which he had previously (Fl. Boliv. 27. *pl. 6. f. 4.* 1839) referred to *Sphaerococcus fragilis* Ag.

Family GELIDIACEAE

GELIDIUM Lamour. Essai 41. 1813

Cornea Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 57, 83. 1809.
Clavulata Stackh. loc. cit. 95, 97.
Acrocarpus Kütz. Linnaea **17**: 103. 1843; Phyc. Gen. 405. 1843.
Echinocaulon Kütz. loc. cit.

Gelidium crispum sp. nov.

Rather rigid, crispate, cespitose, 7–12 cm. high, sparingly and often irregularly branched below, closely but rather irregularly 2–3-pinnate in median parts, 1–2-pinnate towards apices; main axes subterete at the very base, soon strongly complanate or ancipital, subcostate, 2.0–3.2 mm. broad, about 4–6 times broader than thick, their margins subentire below, becoming irregularly sinuate-dentate, erose-dentate, or bidentate above; primary pinnae mostly 8–50 mm. long, their axes 1–2.5 mm. broad; secondary pinnae mostly 5–15 mm. long, ligulate or spatulate; peripheral cells of the cortex about 5.5–11 μ in maximum diameter in surface view; cells of the medulla mostly 15–40 μ in diameter in a cross section, the intercalated rhizoidal hyphae moderately numerous; sporangiophyls 1–4 mm. long, the simpler subspatulate, often inflated towards their apices, with erose-denticulate or sublobate, more or less undulate-crisped margins, the larger pinnately or occasionally subpalmately once or twice irregularly compound, commonly much crisped and contorted, often with short incrassate lobes from the face of the sporangiophyl; cystocarps not seen. [PLATE 33; PLATE 34, FIGURES 1–6.]

Pescadores Islands, region of Ancón, Feb. 12, 1907, on barnacles, abundant, *Coker 80 p.p.*

Gelidium crispum perhaps finds its closest relative in the Chilean *G. lingulatum* J. Ag. We have not seen Agardh's type of the latter, but through the kindness of Mme. A. Weber-von Bosse we have seen the specimen represented by Kützing's figures (Tab. Phyc. **18**: *pl. 65. f. a–c.* 1868), which were later accepted by J. Agardh as representing his species. *G. crispum* differs from this very much in general habit, resembling much more the South African *Gelidium pristoides* (Turn.) Kütz. The main axes of *G. lingulatum* are 0.5–1.0 mm. broad, while in *G. crispum* they are 2–3 mm. broad. From *G. pristoides* the Peruvian plant differs in the less well-defined costa, the smaller less spinescent marginal teeth, the less regularly lobed sporangiophyls, the larger cortical cells, etc.

Gelidium crispum may possibly be considered an ally of *G. serrulatum* J. Ag., originally described from La Guayra, Venezuela, but it differs much in habit, recalling the South African *G. pristoides*, while *G. serrulatum* resembles *G. cartilagineum* or large forms of *G. corneum*. *Gelidium crispum* is rather less rigid and corneous than *G. serrulatum* and is less regularly pinnate and less compound

in its branching; the main axes toward the apices are about twice as broad as the corresponding axes in *G. serrulatum;* the marginal teeth when present are more acute and more irregular in form; the sporangiophyls are commonly lobed or compounded, while those of *G. serrulatum* are described as merely serrate. We have examined in a cursory manner the type of *Gelidium serrulatum* in the Agardh herbarium, but have been able to study more carefully an authentic sterile fragment of the La Guayra material through the courtesy of Professor W. G. Farlow.

Of *Gelidium seminudum* J. Ag. (Linnaea **15**: 17. 1841; Sp. Alg. **2**: 474. 1852), described from Peru, we have seen only a photograph of the type specimen. It was compared by Agardh with *G. cartilagineum* and justly so, while Dr. Coker's plant, as remarked above, bears a much closer resemblance to *G. pristoides.* The primary pinnae of *G. seminudum* were described as 4–5-pollicares (10–12.5 cm. long), while in ours they are mostly 0.8–5.0 cm. long; the pinnules were described as "filiform," a term that would not suggest itself in connection with the pinnules of our specimens; the description of the sporangiophyls is hardly applicable and, altogether, *Gelidium seminudum* seems amply different from our *G. crispum.*

From the type specimen of *Gelidium filicinum* Bory, *G. crispum* differs in being less regularly and less densely pinnate and less compound (*G. filicinum* is 3–4-pinnate from the very base); the main axes are 2.0–3.2 mm. broad, while those of *G. filicinum* are 0.5–1.0 mm. broad; the type of *G. filicinum* has been assumed to be sterile, but some of its branchlets have the appearance of being incipiently tetrasporic and if this is true the sporangiophyls are evidently much simpler than those of *G. crispum.*

PLATE 33. *Gelidium crispum*

Photograph of two clusters of plants (from liquid preservative), natural size.

PLATE 34, FIGURES 1–6. *Gelidium crispum*

1. Apical portion of the main axis, showing young sporangiophyls, etc.
2. Apical portion of a primary pinna, with more lobed and dissected sporangiophyls.
3. A portion of the margin of a primary pinna towards apex (rather more serrulate than usual).

4, 5. Outline of cross sections of main axis and primary pinnae.

6. A large compound or much dissected sporangiophyl.

All of the figures are drawn from the type material (Pescadores Islands, region of Ancón, *Coker 80 p.p.*). Figures 1, 2, 4–6 are enlarged 9 diameters; 3, 40 diameters.

Gelidium caloglossoides sp. nov.

Thallus small, 0.8–1.5 cm. long, repent, complanate throughout, more or less divaricate-radiately branched at the frequent attachment nodes, with usually 2–5 branches from either margin at each node, often with 1–4 minute rudimentary ventral branches anterior to the older cylindric or capitate-cylindric boring haptera; main axes with 6–14 nodes, some of the branches developing in like fashion; main axes linear or ribbon-shaped, mostly 0.25–0.8 mm. wide, 60–130 μ thick, 2–8 times as wide as thick; younger branches lanceolate, acuminate or acute, the surface cells in the apical region in very distinct oblique rows; surface cells in mature sterile parts averaging 11 μ in maximum diameter; medulla showing in cross section a single (very rarely imperfectly double) row of large cells, these (and sometimes the adjacent cells) in the older parts more or less surrounded by rhizoidal hyphae; sporangiiferous branches free, ascending, linear or linear-spatulate, gradually narrowed to the base, the acute or subacute apex commonly deflexed, the sporangia mostly in distinct oblique lines. [PLATE 34, FIGURE 7; PLATE 35.]

On shells, "dredged in 2½ fathoms," Island of San Lorenzo, *Coker 59 p.p.*

Gelidium caloglossoides is manifestly allied to the somewhat variable *G. pusillum* (Stackh.) Le Jol., yet we feel that it would be an error to attempt to associate it with that species as a form or variety. Of all the forms that have been referred to *G. pusillum* it is perhaps the most suggestive of that figured and described by Okamura as *Gelidium repens* (Bot. Mag. Tōkyō **13**: 8. *pl. 1. f. 5–8.* 1899) and distributed by him in Alg. Jap. Exsicc. no. 5. But from all forms and conditions of *G. pusillum*, *G. caloglossoides* appears to differ in being complanate throughout, in being more regularly bilateral, in having peripheral cells of about twice the average diameter of the corresponding cells in that species, in having the cells of the younger apical parts in much more regular rows, in the more regularly arranged tetrasporangia, and in the character of the medulla, which shows in cross section a single row of large cells, while the medulla of *G. pusillum* is made up of irregularly arranged cells. The regularity of the cell arrangement in the apical regions suggests *Caloglossa* and certain other Delesseriaceae, and this peculiarity, together with the prostrate repent habit of the plant, has determined the choice of the specific name.

PLATE 34, FIGURE 7. *Gelidium caloglossoides*

A part of a cross section of the thallus, showing series of large cells surrounded by rhizoidal hyphae in the medulla, × 390.

PLATE 35. *Gelidium caloglossoides*

1. The figure shows the greater part of a single tetrasporic plant in dorsal view. The dots at the nodes indicate the position of the ventral haptera, which are commonly visible through the thallus.
2. Portion of another tetrasporic plant in ventral view. (The arrow indicates direction of the main axis.)
3. One of the apices of the thallus in latero-ventral view, showing a young boring haptere in profile.

4, 5. Outlines of cross sections of the thallus, each passing through a haptere.

6, 7. Outlines of cross sections of narrower and less flattened segments of the thallus.

8. A median longitudinal or sagittal section of a thallus segment, showing protoplasts in outline.
9. Apex of a young narrowly acuminate branch, showing apical and surface cells.
10. Apex of one of the main segments, showing apical and surface cells.
11. A node in ventral view, showing haptere and four rudimentary ventral branches just anterior to it.
12. Tetrasporangia and vegetative surface cells. (The arrow points towards apex of the sporangiophore.)

All of the figures are drawn from the type material (Island of San Lorenzo, *Coker 59 p.p.*). Figures 1 and 2 are enlarged 9 diameters; 3 and 11, 40 diameters; 4–7, 55 diameters; 8 and 12, 245 diameters; 9 and 10, 675 diameters.

Gelidium pusillum, epiphytic on *Gigartina Lessonii*, has been reported from Paita by Piccone (Alg. Vettor Pisani 75. 1886). The same author reports *Gelidium crinale chiloense* from the Island of San Lorenzo, near Callao.

(?) GELIDIUM FILICINUM Bory Voy. Coquille, Bot. Crypt. 162. 1828

Taken from the stomach of a green turtle. Lobos de Afuera, Mar. 25, 1907, *Coker 146 p.p.*

Fragments 4–5 cm. long, tripinnate; main rhachides terete or nearly so, becoming flattened above, 1 mm. in diameter; branches distichous or here and there irregularly 3- or 4-ranked, the margins of ultimate ramuli obscurely crenate-dentate; sporangiophores spatulate, lingulate, or obovoid-cuneate, 1–3 mm. long, 0.7–1.0 mm. in greatest width, their margins dentate.

The material is so evidently fragmentary that no reliable conclusions as to the size of the plants can be drawn, but they are probably smaller and are certainly less densely pinnate than those

(sterile ?) originally described by Bory and supposed to have been collected in Chile, though suspected by Bory to have come, in reality, from the Society Islands. The type of *Gelidium filicinum* in the herbarium of the Muséum d'Histoire Naturelle consists according to M. Hariot (in litt.) of a single large plant about 11 cm. broad and 8 cm. high and a smaller, apparently identical fragment marked *a*. On the sheet is written in Bory's hand: "donné comme de la Concepcion au Chili par Durville; mais l'échantillon *a* vient bien évidemment de Borabora, où le recueillit Lesson, 1825." In some respects the fragments from the turtle's stomach suggest also the Chilean plant described by J. Agardh as *G. lingulatum* and figured by Kützing, but they are more regularly and closely bi-tripinnate than that and there is no evidence that the fertile branches are ever lobed or compound.

Family GIGARTINACEAE

CHONDRUS Stackh. Ner. Brit. xv, xxiv. 1797

Polymorpha Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 55, 71. 1809.

CHONDRUS CANALICULATUS (Ag.) Grev. Alg. Brit. lv. 1830. Kütz. Tab. Phyc. **17**: *pl.* 53. *f. a, b.* 1867

Sphaerococcus canaliculatus Ag. Sp. Alg. **1**: 260. 1822.

Growing on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 192 p.p.* (sterile); also, in same locality, July 13, 1908, *Coker 492 p.p.* (cystocarpic, PLATE 36).

The specimens are larger, less dissected, and commonly have broader segments, especially towards the apices, than is the case in Agardh's Chilean type of the species, a photograph of which we have seen through the courtesy of Professor Nordstedt. The plants attain a height of 7–9 cm., are rather regularly 4–7 times dichotomous; the main segments are broadly canaliculate or slightly concavo-convex, 8–15 mm. wide or sometimes 20 mm. under the dichotomies, 0.65–0.9 mm. thick, narrowing down to 3–6 mm. wide or sometimes only 1.5–2.0 mm. at the apices; the cystocarps (in no. 492) are numerous, all on one (convex) side, often somewhat aggregated near the margins, very protuberant,

depressed-hemispheric, discoid, or button-shaped, finally 2 mm. in diameter and projecting 1 mm., the basal half at least with a well-defined pericarp (inner involucre).

This species has been reported from Arica, Chile, by Montagne (Fl. Boliv. 26. 1839), but not heretofore from the present limits of Peru, so far as we are aware. We have not seen the specimens from Cobija and Valparaiso referred by Montagne (loc. cit. 25) to varieties of *Chondrus crispus*, but from his remarks in Gay's Flora Chilena (8: 340. 1852) we suspect that he subsequently placed them with *C. canaliculatus*.

PLATE 36.

Photograph of a cystocarpic specimen (from liquid preservative—*Coker 492 p.p.*), natural size.

Chondrus violaceus Sond., described from Peru, we consider to be referable to *Gymnogongrus furcellatus*, q. v.

Iridaea laminarioides Bory, originally described from Concepcion, Chile, has been attributed to the region of Callao by Montagne (Fl. Boliv. 24. 1839).

Iridaea violacea Kütz., which was based upon Peruvian material, is apparently identical with *Grateloupia Cutleriae*, under which species it is further discussed.

GIGARTINA Stackh. Mém. Soc. Imp. Nat. Moscou 2: 55, 74. 1809.

Mammillaria Stackh. loc. cit.

GIGARTINA CHAMISSOI (Ag.) J. Ag. Alg. Med. et Adriat. 104. 1842; Sp. Alg. 2: 267. 1851. Mont. Voy. Bonite, Bot. Crypt. 71. 1846

Sphaerococcus Chamissoi Ag. Icon. Alg. Ined. 1: *pl. 6.* 1820; Sp. Alg. 1: 278. 1822. Bory, Voy. Coquille, Bot. Crypt. 168. 1828. Mont. Fl. Boliv. 30. 1839.

Sphaerococcus uvifer Bory, loc. cit. 171.

Gracilaria Chamissoi Grev. Alg. Brit. liv. 1830.

Chondracanthus Chamissoi Kütz. Phyc. Gen. 399. *pl. 75. f. 2.* 1843.

Chondroclonium Chamissoi Kütz. Sp. Alg. 740. 1849; Tab. Phyc. 17: 20. *pl. 66. f. a–d.* 1867.

The original specimens of *Gigartina Chamissoi* were collected

by Chamisso on the shores of Chile. Dr. Coker's Peruvian material does not include anything that precisely matches the Chilean type, though his 123 p.p., from the Bay of Pacasmayo, "brought up on a fish hook from six fathoms," makes a close approach to it. However, *Gigartina Chauvinii* and *G. Lessonii*, though both also typically from Chile or farther south, occur in Coker's Peruvian collections in essentially typical forms and both appear to be connected with the earlier-described *G. Chamissoi* by a full series of intermediates. *Gigartina Lessonii* and *G. Chauvinii* differ principally in the width of their main axes. They are different enough in their extreme forms, as may be seen by comparing our photographs (PLATES 37 and 38) and we find a certain convenience in falling in with the current custom of referring to them as "species," even though confessing that we do not know how to draw lines separating the two from each other or either from *G. Chamissoi*. *Gigartina Chamissoi* has been reported from Callao and Paita by Montagne (loc. cit.) and from Pisco by Pilger (Hedwigia 48: 180. 1908).

GIGARTINA LESSONII (Bory) J. Ag. Sp. Alg. 2: 268. 1851; 3^1: 192. 1876

Sphaerococcus Lessonii Bory, Voy. Coquille, Bot. Crypt. 169. 1828.

"On rocks near N. E. end of water front of Callao, purplish," Dec. 27, 1906, *Coker 17 p.p.*; in beach drift, La Punta, region of Callao, "green in color," Dec. 1906, *Coker 23 p.p.*; on tide rocks, Bay of Ferrol, region of Chimbote, Mar. 1, 1907, *Coker 119 p.p.*; Lobos de Tierra, Apr. 2, 1907, *Coker 151 p.p.*; on surf-washed rocks, "dark olive-green," Chincha Islands, June 18, 1907, *Coker 195a* (PLATE 37); "in one fathom, olive-green," Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09640 p.p.*; from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*

The best-developed of these specimens, though possibly not the most typical in the historic sense, are Coker's *195a* (PLATE 37). The plants under this number reach a length of 20 cm., they are often 1–4 times dichotomous, the main axes are nearly terete below but are for the most part distinctly complanate and about 2 mm. broad (often only 0.5–1.0 mm. after drying); the tetrasporic

plants are rather sparingly and irregularly pinnate; the cystocarpic more regularly and closely pinnate; cystocarps occasionally solitary on the ramuli, but mostly in short-spicate, moriform, or fusiform rostrate clusters of 4–15.

Although the historic type of *Gigartina Lessonii* came from Chile, Bory, in the place of original publication, cites also specimens from Paita, Peru, and these Peruvian specimens are preserved with the Chilean in the herbarium of Bory de St. Vincent in the Muséum d'Histoire Naturelle of Paris. The species has been reported from Paita also by Piccone.* That Bory had difficulty in always distinguishing his *Sphaerococcus Lessonii* from Agardh's *S. Chamissoi* is shown not only in his general discussion of the species, but also in his herbarium, where one well-developed cystocarpic specimen is annotated in Bory's hand, "Litigieux entre les *Sphaerococcus Lessonii* N. & *Sphaerococcus Chamissoi* Ag."

The plants from "Guanchaco" listed by Humboldt, Bonpland, and Kunth (Nov. Gen. et Sp. Pl. 418. 1825) as *Sphaerococcus Teedii*, those from Callao referred by Montagne (Fl. Boliv. 30) to *Gigartina Teedii*, and those from Paita referred by Piccone (loc. cit.) to *G. canaliculata* as var. *peruviana* we have not seen, but specimens in Dr. Coker's collections suggesting these two species we take to be conditions of *G. Lessonii.* Such specimens are rather less rigid and spinescent on drying than either *G. Teedii* or *G. canaliculata;* so far as we have observed, they are usually young and sterile, never cystocarpic.

PLATE 37. *Gigartina Lessonii*

Photograph of cystocarpic specimens (from liquid preservative—*Coker 1950*), reduced to about five sixths of the natural dimensions.

GIGARTINA CHAUVINII (Bory) J. Ag. Alg. Med. et Adriat. 104. 1842; Sp. Alg. **2**: 268. 1851. Mont. Voy. Bonite, Bot. Crypt. 72. 1846

Sphaerococcus Chauvinii Bory, Voy. Coquille, Bot. Crypt. 165. *pl. 20.* 1828. Mont. Fl. Boliv. 29. 1839.
Rhodomenia Chauvinii Grev. Alg. Brit. xlix. 1830.

* Alg. Vettor Pisani 57. 1886; Mem. R. Accad. Lincei IV[a]. 6: —(30). 1889.

Chondracanthus Chauvinii Kütz. Phyc. Gen. 400. 1843.
Chondroclonium Chauvinii Kütz. Sp. Alg. 741. 1849; Tab. Phyc. 17: 21. *pl. 70.* 1867.
Chondroclonium versicolor 17: 21. *pl. 69. f. a, b.* 1867.

On rocks, N. E. side of San Lorenzo Island, region of Callao, Jan. 11, 1907, *Coker 5 p.p.*; in beach drift, La Punta, region of Callao, "green in color," Dec. 1906, *Coker 23 p.p.*; "uyos," from the market, Lima, "the common market form, used in salads, soups, or fritters, but not generally esteemed on the best tables," Jan. 14, 1907, *Coker 26 p.p.*; growing in a tide-pool, La Punta, region of Callao, Jan. 25, 1907, *Coker 33* ("green—the long slender specimen was reddish brown"; mostly rather small and young and often smooth or nearly so on the rachides); in beach drift, same locality and date, *34* (PLATE 38) and *35 p.p.* (34 is cystocarpic and tetrasporic; plants attaining length of 70 cm. and the rachides a maximum width of 3–4 cm.; cystocarpic specimens sometimes more or less naked on faces of the rachides); dredged in "about 2½ fathoms, color red," San Lorenzo Island, Feb. 5, 1907, *Coker 60 p.p.* There are also in the herbarium of the New York Botanical Garden specimens brought in 1901 from the markets of Lima by M. Albert de Lautreppe, who found them offered for sale with live shrimps, etc.

We have not seen the original specimens used by Bory in establishing his *Sphaerococcus Chauvinii*, but the excellent figures published by him evidently leave little or nothing to be desired, so far as the recognition of the forms that he had in mind is concerned. Bory seems to have had before him a considerable number of specimens, ranging as to original locality from Paita, Peru, to Cape Horn. He states that he first received the species from Chauvin, who had numerous and magnificent specimens of it from Cape Horn, and it seems probable that a Cape Horn specimen may prove to be entitled to be considered the technical type of the species.

In our largest specimens the main axes are slightly broader than the broadest figured by Bory and in certain others the axes are considerably narrower than the narrowest figured by him. The narrower forms appear to intergrade hopelessly with *G. Lessonii*. In its narrower, more regularly pinnate conditions, it is

manifestly the *Chondroclonium versicolor* of Kützing. In its narrowest pinnate forms it sometimes suggests slightly the larger broader conditions of *Grateloupia filicina*, a resemblance that is heightened by its customary dark green color.

Since the publication of the results of the voyage of La Coquille, *Gigartina Chauvinii* has been recorded from Peru by Montagne, Kützing, J. Agardh, Piccone, Pilger, and perhaps other writers. It appears to have been collected at Callao by the Wilkes Expedition (in 1839), according to a specimen in the Columbia College Herbarium, under the name *G. Chamissoi*, though it is not mentioned in Bailey and Harvey's report on the algae of that expedition.

PLATE 38. *Gigartina Chauvinii*

Photograph of a part of a cystocarpic plant (from liquid preservative—*Coker 34*), reduced to about five sixths of the natural dimensions.

Gigartina glomerata sp. nov.

Densely cespitose, 3–5 cm. high, rather firm and rigid (in preservative fluid), corneous when dry; main axes of cystocarpic plants subterete or lightly compressed, 1–3 mm. in diameter, usually 1–3 times subdichotomous below, otherwise naked for 1–2.5 cm. in basal and median parts, bearing toward their apices at first subdistichous, later irregularly polystichous, short, simple or compound branches; the simple branches mammiform or subovoid; the compound branches irregularly and densely short-ramose, or longer (5–8 mm.) and 2–5 times closely, often somewhat palmately or pedately subdichotomous or cervicornous, sometimes a little inflated towards the apex with a subrotate or coronate verticil of short branchlets, or very irregularly fasciculate-ramose, the ultimate ramuli mostly short-digitiform, patent or subdivaricate, obtuse or acute, the penultimate ramuli commonly narrowed towards the base; branching of sterile plants irregularly distichous above, at length irregular in all planes, the ultimate ramuli mostly acuminate, some of the lower ovoid or short-digitiform and somewhat constricted at the base; cystocarps aggregated or occasionally solitary, subglobose or hemispheric, 1–1.5 mm. in diameter, naked, variously disposed on ultimate ramuli, these shorter or more contracted than the sterile, the pericarp (inner involucre) well developed or almost wanting. [PLATE 39 and PLATE 40, FIGURES 1–11.]

Attached to shells of mussels on rocks, N. E. side of San Lorenzo Island, region of Callao, Feb. 5, 1907, *Coker 55* (type—

PLATE 39, FIGURE A; PLATE 40, FIGURES 1–3); on barnacles, in company with *Gelidium crispum*, Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 80 p.p.* [PLATE 39, FIGURE B; plate 40, FIGURES 4–11.]

The two collections cited differ considerably in habit, as will be noted from our published photographs. In 80 the plant is very sparingly cystocarpic and the branch system has a much greater development than in 55, which is crowded with cystocarps and has contracted or aborted branches. Branches that are 2–5 times dichotomous in 80 are often represented in 55 by simple mammiform or ovoid excrescences. Yet, among the plants under no. 55, in which the material is more ample than in the other, are some in which the branch system appears to be of an intermediate character.

The form of *Gigartina glomerata* collected by Dr. Coker under no. 80 bears a certain superficial resemblance to small densely branched conditions of the Californian *G. canaliculata* Harv., but is distinguished at once by the irregular branching, the unarmed conceptacles, etc.

The abundance of the cystocarps in no. 55 has suggested the possibility of relationship with the New Zealand *Chondrus tuberculosus* Hook. f. & Harv. [*Gigartina tuberculosa* (Hook. f. & Harv.) Grun.], which has been reported also from the Straits of Magellan, and to which Dr. Coker's 565 p.p. from Mollendo appears to belong, but this no. 55 differs in being more rigid, in its less sustained dichotomy, narrower, less flattened and less canaliculate segments, narrower more acute apices, in bearing cystocarps on small ramuli instead of upon the main segments, etc.

The somewhat palmate or pedate mode of ultimate branching sometimes exhibited by sparingly cystocarpic plants of no. 80 p.p. has suggested also the possibility of affinity with the evidently more slender *Gigartina bactracopus*, described by Bory from Concepcion, Chile, but an examination of Bory's original material, which we have been permitted to make through the courtesy of M. Hariot, shows that plant to have the structure of an *Ahnfeltia* or *Gymnogongrus*, as already recognized by Hariot.*

Dr. Coker's plants are in some respects suggestive of Bory's

* Miss. Sci. Cap Horn 5: 70. 1889.

Gigartina contorta, which J. Agardh and others have accepted as a true *Gigartina*, but an examination of the original of this, also from Concepcion, Chile, and also now preserved in the Muséum d'Histoire Naturelle at Paris, shows that it is not a Gigartinaceous plant in any modern sense, as it has a Gracilarioid structure.

It is probable that the irregularity of the branching makes our *Gigartina glomerata* most at home in J. Agardh's *Aciculares* tribe of the genus, as the species were last rearranged by him (Anal. Alg. 5: 9. 1899).

PLATE 39. *Gigartina glomerata*

A. Photograph of the type specimen (*Coker 55*, cystocarpic—from liquid preservative), natural size.

B. Photograph of Coker's no. 80 p.p. (from liquid preservative, natural size).

PLATE 40, FIGURES 1–11. *Gigartina glomerata*

1. Terminal portion of one of the main branches of a sterile plant.
2, 3. Terminal portions of main axes of copiously cystocarpic plants.
4, 6, 7. Figures showing the ultimate ramification of a sparingly cystocarpic plant.
5, 8. Ramuli bearing cystocarps.
9. Outline of cross section of an ultimate ramulus.
10, 11. Outline of cross sections of main axes.

Figures 1–3 are drawn from the type material (San Lorenzo Island, region of Callao, *Coker 55*); 4–11, from *Coker 80 p.p.* (Pescadores Islands). All of the figures are enlarged $6\frac{2}{3}$ diameters.

GIGARTINA TUBERCULOSA (Hook. f. & Harv.) Grun.; Piccone, Alg. Vettor Pisani 58. 1886. Hariot, Miss. Sci. Cap Horn 5: 68. 1889

Chondrus tuberculosus Hook. f. & Harv. in Hook. f. Fl. Antarct. 188. 1845.

Nothogenia tuberculosa Kütz. Sp. Alg. 793. 1849; Tab. Phyc. **19**: *pl. 46. f. c, d.* 1869.

On rocks in the surf, Mollendo, August 1908, *Coker 565 p.p.* [PLATE 40, FIGURES 12–17; PLATE 41.]

Only the few cystocarps of which figures are herewith published have been noted on Dr. Coker's material; one of these is evidently mature, the others immature. We have not seen the Cape Horn specimens referred to this species by Grunow and by Hariot, but the Peruvian plant seems to differ somewhat from the New Zealand originals preserved in the Royal Botanic Gardens at Kew, though

the difference is less than is generally conceded to occur in related species such as *Chondrus crispus.* The Peruvian plant is a little less flattened and is more fastigiate in its branching, its somewhat narrower segments are less closely and less patently flabellate-dichotomous towards the apices, and its substance is rather more corneous when dry. Dr. Coker's 565 p.p. may be more fully characterized as follows:

Densely cespitose and somewhat fastigiate, 3.5–7 cm. high, succulent, flaccid, and often transversely corrugated below (in preservative fluid), corneous when dry, simple or 1–7 times flabellately dichotomous, subterete or lightly compressed and 2–3 mm. in diameter at base; segments linear or linear-obcuneate, strongly flattened and canaliculate or occasionally subterete, 2.5–5 mm. broad, usually 2–3 times as broad as thick, mostly 1–5 cm. long, suberect or erecto patent, the axils somewhat rounded, the apices broadly obtuse, lateral prolifications very rare; cystocarps on concave or convex faces of the segments, scattered or aggregated, 1–1.5 mm. in diameter, finally subconic or mammiform and highly protuberant, the pericarp (inner involucre) well developed.

The delicate arachnoid vegetative structure of Dr. Coker's 565 is very well illustrated by Kützing's figure of the structure of his South African *C. scabiosus* (Tab. Phyc. 17: *pl. 63. f. b.*).

Chondrus tuberculosus was included in "Species inquirendae" by J. Agardh and seems never to have been admitted to *Gigartina* by him. Whether the species is to be referred to the one or the other of these two genera appears to be a matter of taste and opinion rather than of decisive structural characters. The cystocarps are often sessile upon the main segments or semi-immersed as in typical *Chondrus*, yet (in New Zealand specimens, at least) they are sometimes so protuberant and carry so much vegetative tissue with them that they may be said to occupy reduced ramuli as in *Gigartina.* The cystocarps, in their younger stages, at least, have a well-developed special pericarp as in *Gigartina*, but a similar pericarp exists also in *Chondrus canaliculatus*, which no one seems inclined to remove from *Chondrus* for this reason.

The South African *Gigartina fastigiata* J. Ag., according to photographs of the original specimens kindly furnished by Professor Nordstedt, is a plant of much less pronouncedly fastigiate habit and of much more divergent branching than the Peruvian

and has more pointed apices. In general habit it resembles the New Zealand plant more than the Peruvian, but its segments are only about half as broad as those of the former.

PLATE 40, FIGURES 12–17. *Gigartina tuberculosa*

12. Apical portion of a thallus segment bearing young cystocarps.
13. A single mature cystocarp in surface view of the segment.
14. The same cystocarp in profile in an edgewise view of the thallus segment.
15. Outline of a cross section of a thallus segment near base of the plant.
16, 17. Outlines of cross sections of terminal segments.

All of the figures are drawn from *Coker 565 p.p.* (Mollendo) and all are enlarged $6\frac{2}{3}$ diameters.

PLATE 41. *Gigartina tuberculosa*

A. Photograph of a cluster of very sparingly cystocarpic plants (from liquid preservative—*Coker 565 p.p.*), natural size.

B. Photograph of a portion of the same specimen, showing mode of branching, etc., natural size.

Gigartina lemanaeformis Bory, Voy. Coquille, Bot. Crypt. 151. 1828, described from specimens collected at Paita by d'Urville in 1823, is, we believe, a *Cordylecladia* and will be referred to more fully under that generic name.

Gigartina Gaudichaudii Mont., described from a specimen collected at Paita by Gaudichaud, is apparently *Agardhiella tenera*, q. v.

GYMNOGONGRUS Mart. Fl. Bras. 1: 27. 1833

GYMNOGONGRUS FURCELLATUS (Ag.) J. Ag. Sp. Alg. 2: 318. 1851

Sphaerococcus furcellatus Ag. Sp. Alg. 1: 253. 1822.
?*Chondrus sejunctus* Bory, Voy. Coquille, Bot. Crypt. 160. 1828.
Chondrus furcellatus Grev. Alg. Brit. lv. 1830. Kütz. Tab. Phyc. 17: 16. *pl. 55. f. c–f.* 1867.
Chondrus violaceus Sond.; Kütz. Sp. Alg. 735. 1849; Tab. Phyc. 17: 15. *pl. 51.* 1867.
Chondrus concinnus Kütz. Tab. Phyc. 17: *pl. 57. f. c, d.* 1867.
Chondrus bidens Kütz. Tab. Phyc. 17: 17. *pl. 59. f. c, d.* 1867.
Chondrus coarctatus Kütz. Tab. Phyc. 17: 18. *pl. 60. f. d, e.* 1867.
Gymnogongrus vermicularis forma *americana* J. Ag. Sp. Alg. 3^1: 213. 1876.

On rocks, water-front of Callao, "purplish," Dec. 27, 1906, *Coker 17 p.p.* (PLATE 42; sterile, approaching the *Chondrus violaceus* of Kützing's Tab. Phyc. 17: *pl. 51. f. a*); in beach drift,

La Punta, region of Callao, December, 1906, *Coker 23 p.p.* ("green"—a short plant of compact congested habit, somewhat resembling Kützing's figure of *Chondrus violaceus brevicornis*—Tab. Phyc. 17: *pl. 51. f. f.*, though shorter and more congested; bears abortive or diseased cystocarps); also, in beach drift, same locality, Jan. 25, 1907, *Coker 39* ("green," cystocarpic, near Kützing's *Chondrus violaceus brevicornis*); Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 79* ("green," cystocarpic); in beach drift, same locality and date, *Coker 96;* "brought up on a fish-hook from 6 fathoms," Bay of Pacasmayo, March 14, 1907, *Coker 123 p.p.* (cystocarpic); on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 193 p.p.* (fragment).

None of the specimens collected by Dr. Coker exactly matches the plants originally brought from Peru by Humboldt. Most of them, as already indicated above, resemble the forms figured by Kützing under *Chondrus violaceus.* The species varies greatly as to the size of the plants, the regularity and frequency of the dichotomies, the presence or absence of proliferations, etc. Through the courtesy of Mme. Weber-van Bosse we have been able to study the structure of the plants lying in the Kützing herbarium under the names *Chondrus violaceus* and *C. concinnus* and we can discover no way of distinguishing them specifically from the Humboldtian specimens of *Sphaerococcus furcellatus* in the Agardh herbarium and the herbarium of the Muséum d'Histoire Naturelle of Paris. We have included *Chondrus bidens* Kütz. and *C. coarctatus* Kütz. in the synonymy on the strength of the similarity exhibited by Kützing's figures. J. Agardh, while maintaining *G. furcellatus* as a valid species, cited these names of Kützing's in the synonymy of *Gymnogongrus vermicularis* (Turn.). The *Fucus vermicularis* of Turner antedates the *Sphaerococcus furcellatus* of Agardh and Turner's specific name might be taken up for these Peruvian plants if one were convinced that it was really applicable to them and if one were not troubled by the previous use of the name *Fucus vermicularis* in another sense by Gmelin. As a matter of fact, however, the source of Turner's *F. vermicularis* was wholly unknown to its describer, but it was probably South African. The apparently original cystocarpic specimen in the herbarium of the Royal Gardens at Kew is

evidently a *Gymnogongrus*, but it is, on the whole, a more rigid and a more terete plant than any of these from Peru that we are referring to *G. furcellatus;* the walls of its medullary cells are thinner and seem less inclined to swell when soaked out in water.

The type of Bory's *Chondrus sejunctus*, from Concepcion, Chile, we have examined through the courtesy of Messrs. Mangin and Hariot of the Muséum d'Histoire Naturelle. It is sterile (and bears no *Actinococcus*) and in habit makes an approach to Bory's *Sphaerococcus disciplinalis* in showing a tendency to polychotomy, but is thicker and more rigid throughout and is subterete below and in some of its ultimate branches, though, on the whole, decidedly flattened toward the extremities.

PLATE 42. *Gymnogongrus furcellatus*

A photograph of Dr. Coker's no. 17 p.p. (from liquid preservative), natural size.

GYMNOGONGRUS DISCIPLINALIS (Bory) J. Ag. Sp. Alg. 2: 319. 1851; 3^1: 210. 1876

Sphaerococcus disciplinalis Bory, Voy. Coquille, Bot. Crypt. 172. 1828.

In beach drift, La Punta, region of Callao, January 25, 1907, *Coker 38 p.p.* (fragment only); on rocks, Ancón, February 13, 1907, *Coker 95 p.p.* (PLATE 43).

While we have refrained from including *Sphaerococcus disciplinalis* Bory in the synonymy of *Gymnogongrus furcellatus* we are in some doubt as to what characters may be depended upon to distinguish it from Agardh's species. Bory founded his *S. disciplinalis* on a considerable wealth of material, including specimens of somewhat varied habit from Cape Horn, coming to him from the herbarium of Chauvin, specimens from the western* coast of South America, communicated by Lamouroux in 1824, and specimens from Concepcion, Chile, brought by d'Urville and Lesson. The Cape Horn specimens were not only mentioned first by Bory, but one of the specimens in his herbarium, inscribed in his hand "*Sphaerococcus disciplinalis* N. coq. p. 172, du Cap Horn, par M^r^ Chauvin de Caen, 1824," has, more than the other specimens, the elongate subfasciculate flagelliform branches that evidently sug-

* The inscriptions in Bory's herbarium indicate that the "côtes orientales" of his text was a misprint or slip of the pen for "côtes occidentales."

gested the specific name *disciplinalis*, and this may therefore be considered the technical "type" of the species. The thallus of the original specimens of *S. disciplinalis* is, on the whole, thinner and less rigid than that of *Gymnogongrus furcellatus*, the branching is more flabellate, and there is often a tendency to tri- or polychotomy and to a pronounced widening under the forkings. But all of these characters appear to us to be rather unstable. We find no cystocarps in Bory's original material and none in Coker's plants, but it is a fact of possible significance that three of Bory's specimens (the type from Cape Horn, the d'Urville specimen from Concepcion, and one of the Lamouroux specimens), as well as the two Coker numbers, bear an *Actinococcus*, which doubtless accounts for the "gongyles" described by Bory. None of the specimens that we have referred to *G. furcellatus* seems to carry the *Actinococcus*. Coker's 95 p.p. differs from Bory's originals in its thicker more rigid thallus (often 1 mm. or more thick), yet departs from typical *G. furcellatus* and approaches typical *G. disciplinalis* in the broadening under the principal forkings, the tendency to polychotomy, the more rounded or wide-angled axils, etc. *Gymnogongrus disciplinalis* has been attributed to Peru by J. Agardh,* who in his latest writings on the genus seems, rather curiously, to restrict the species to Peru, and by Piccone.†

PLATE 43. *Gymnogongrus disciplinalis* and *Actinococcus mollis*
A photograph of Coker's 95 p.p. (from liquid preservative), natural size.

AHNFELTIA Fr. Corp. Fl. Suec. 1: 310. 1835

AHNFELTIA DURVILLAEI (Bory) J. Ag. Sp. Alg. 2: 313. 1851; 3[1]: 207. 1876

Polyides Durvillaei Bory, Voy. Coquille, Bot. Crypt. 138. 1828.

Gracilaria concinna Mont. Voy. Bonite, Bot. Crypt. 100. 1846. Not *G. concinna* (R. Br.) J. Ag. Alg. Med. et Adriat. 104. 1842.

Ahnfeltia concinna Auct. (at least, as far as most Peruvian specimens are concerned). Possibly not *A. concinna* J. Ag. Öfv. Kongl. Vet.-Akad. Förh. 4: 12. 1847. [Hawaiian.]

* Sp. Alg. 3[1]: 210, 211. 1876.

† Alg. Vettor Pisani 61. 1886.

Plocaria Durvillaei Mont. in C. Gay, Hist. Fis. Pol. Chile Bot. **8**: 295. 1852; *pl. 16. f. 2.* 1854.

Ahnfeltia Polyides Aresch. Act. Reg. Soc. Sci. Upsal. III. **1**: 355. 1854.

Gymnogongrus Polyides Kütz. Tab. Phyc. **19**: 26. *pl. 70.* 1869.

On tide rocks, Bay of Ferrol, region of Chimbote, Mar. 1, 1907, *Coker 119 p.p.* (PLATE 44); "common on surf-beaten rocks," Guañape Islands, Mar. 7, 1907, *Coker 121 p.p.*; "very abundant on surf-washed rocks" (photograph, *in situ*, PLATE 45, FIGURE *A*), Lobos de Afuera, Mar. 25, 1907, *Coker 139 p.p.*; "abundant on rocks," Lobos de Tierra, Apr. 2, 1907, *Coker 150c* and *150d;* "olive-green, abundant, but less so than corresponding weed in the north, i. e., Lobos Islands," Chincha Islands, June 18, 1907, *Coker 193b* (PLATE 46); also same locality, July 13, 1908, *Coker 492 p.p.*; "from rocks in the surf," Mollendo, August, 1908, *Coker 565 p.p.*

This species was established by Bory on specimens from Paita, Peru, and Concepcion, Chile, with incidental mention of a specimen from Otaiti [Tahiti]. The Peruvian specimens are not only mentioned first, but are designated "A" in the Bory herbarium, and may be fairly considered the type of the species. They differ little from the Chincha Islands specimen shown in our photograph, but are rather less copiously dichotomous and are slightly more proliferous.

The specimens often bear cystocarps of a Gigartinoid character, as described by J. Agardh for his *Ahnfeltia concinna* (Sp. Alg. **2**: 312. 1851) and by Areschoug for his *Ahnfeltia Polyides*, and as figured by Montagne (loc. cit.) and by Kützing (loc. cit.). Schmitz (Flora **77**: 396. 1893) was apparently of the opinion that such plants belong to the genus *Gymnogongrus* and accordingly in Engler & Prantl, "Die näturlichen Pflanzenfamilien" (1^2: 366. 1896) Schmitz and Hauptfleisch have defined *Ahnfeltia* as having "Sporangien, Antheridien und Cystocarpien unbekannt." Possibly certain other phycologists would consider the existence of proper cystocarps in these Peruvian plants to be sufficient ground for recognizing the species as belonging to *Gymnogongrus* rather than to *Ahnfeltia*, but we are inclined to agree with Areschoug and with J. Agardh in the opinion that in habit and general vegetative structure these Peruvian plants have rather more in common with the type of *Ahnfeltia* than with the type of *Gymnogongrus*.

The cystocarps of the *Ahnfeltia* are deep-seated, often reaching the central axis of the medulla, and are wholly destitute of any special pericarp; as they approach maturity, irregular usually inconspicuous pores are formed, commonly several to a cystocarp,* leading through the cortex to the surface; the walls of these canals sometimes become colored a brownish yellow, apparently through decay of the abutting cells. In the early stages of the formation of the cystocarp, delicate hyphae, suggesting the presence of a parasitic fungus or alga, may be seen running among the larger cells and sometimes apparently fusing with them; these we take to be the sporogenous filaments, though we have not been able to follow out their history and connections with full satisfaction.

PLATE 44. *Ahnfeltia Durvillaei*

Photograph of a cystocarpic specimen (*Coker 119 p.p.*—from liquid preservative), natural size.

PLATE 45, FIGURE *A*. *Ahnfeltia Durvillaei*

A photograph taken by Dr. Coker (apparently at low tide), showing the cushions formed by this species as it grows on surf-washed rocks at Lobos de Afuera (*Coker 139 p.p.*).

PLATE 46. *Ahnfeltia Durvillaei*

Photograph of a sterile specimen (*Coker 193b*—from liquid preservative), differing somewhat in habit from the cystocarpic specimen shown in plate 44; natural size.

Ahnfeltia Polyides Aresch. appears to have come from the Chincha Islands, and, according to material distributed by Areschoug, consisted of typical *A. Durvillaei* and other specimens approaching the following variety:

Ahnfeltia Durvillaei implicata (Kütz.) comb. nov.

Tylocarpus implicatus Kütz. Phyc. Gen. 411. 1843.

Gymnogongrus implicatus Kütz. Sp. Alg. 789. 1849; Tab. Phyc. 19: 25. *pl. 69. f. a–c.* 1869.

Differing from the type in denser habit of growth, the more frequent and close-set dichotomies (often pseudo-3–4-tomous), and the intricate often deflexed branches.

On rocks, San Lorenzo Island, region of Callao, Jan. 11, 1907,

* The carpostomes are less numerous and less conspicuous and the cystocarps less central or axial than is indicated by Ada S. McFadden (Univ. California Publ. Bot. 4: *pl. 18. f. 1.* 1911) in her figure of a section of a cystocarp of a Californian specimen referred to *Ahnfeltia gigartinoides* J. Ag.

Coker 5 p.p. (PLATE 45, FIGURE B); also, same locality, Feb. 5, 1907, *Coker 54*, "green, common on the rocks beaten by the surf"; "very abundant on surf-washed rocks," Guañape Islands, Mar. 7, 1907, *Coker 121 p.p.*

This variety evidently grows with the typical form and seems to be connected with it by intermediate conditions.

The original of Kützing's *Tylocarpus implicatus*, which came from Peru, we have been able to examine through the courtesy of Mme. A. Weber-van Bosse.

PLATE 45, FIGURE *B*. *Ahnfeltia Durvillaei implicata*

Photograph of Coker's no. 5 p.p. (from liquid preservative), natural size.

Both the typical *Ahnfeltia Durvillaei* (121 p.p., 139 p.p.) and the variety *implicata* sometimes bear what appears to be a parasite of somewhat the general habit of an *Actinococcus*, but differing in structure and evidently not referable to that genus or to *Sterrocolax* or *Lobocolax*. It forms discoid, subglobose, or irregular cushions 1–3 mm. broad and about 1 mm. thick. A section shows a compact mass of fine very irregularly intertangled branching and anastomosing filaments, bounded externally by a cortex that consists of short anticlinal filaments 2–4 (rarely 6) cells long or may even be reduced to the single layer of superficial cells. Occasionally some of the outer cells have the appearance of becoming slightly enlarged and finally detached (sometimes after a transverse division), but we do not feel confident that we have observed the actual reproductive cells. In a section, the cells of an endophyte (*Erythrocladia* sp.?) vegetating in outer gelatinous walls of the cortex may at first sight simulate monosporangia. The specimens of *A. Durvillaei* from Mollendo (565 p.p.) bear less flattened cushions, sometimes 2 mm. thick or high, and these show a well-differentiated yellowish coarser central part to the medulla and a thick strongly developed cortex composed of obviously and frequently anastomosing anticlinal filaments that are commonly 10–20 cells long. We suspect, however, that the Mollendo plant, in spite of these differences, represents a condition of the same species of parasite as the other cushions on the same host, previously mentioned.

Under the name *Sphaerococcus* (*Gigartina*) *plicatus*, a single "fructiferous" specimen from Callao has been noted by Montagne

(Fl. Boliv. 30. 1839). We have seen no further suggestion of the occurrence of *Ahnfeltia plicata* (Huds.) Fr. in Peru, but this species has been credited to the Magellan Straits region by Hariot (Miss. Sci. Cap Horn 5: 71. 1889) and by others, and closely related, if not identical species [*Ahnfeltia setacea* (Kütz.) Schmitz and *A. elongata* Mont.], occur on the Chilean coasts.

ACTINOCOCCUS Kütz. Phyc. Gen. 177. 1843. Schmitz, Flora 77: 367–418. 1893. Darbishire, Ann. Bot. 13: 253–267. 1899. Heydrich, Ber. Deuts. Bot. Ges. 24: 71–77. 1906

Actinococcus mollis sp. nov.

Cushions hemispheric, subglobose, or irregularly verrucaeform, 0.5–2.0 mm. in diameter (0.45–1.3 mm. high), solitary, gregarious, or occasionally and sparingly confluent, mostly marginal, often on one surface only but sometimes growing through and antipodal-dicephalous, soft and gelatinous, wrinkled and collabent on drying, sessile, affixed by a base $\frac{1}{3}$–$\frac{4}{5}$ as broad; cortical filaments 200–500 μ long, scarcely tapering at apex, their cells (protoplasts*) 8–22 $\mu \times$ 4–6 μ; medullary and rhizoidal cells mostly 5–28 $\mu \times$ 4–11 μ; sporangia four-parted, 16–22 $\mu \times$ 7–13 μ.

On *Gymnogongrus disciplinalis* (Bory) J. Ag., Ancón, Feb. 13, 1907, *Coker 95 p.p.* (type—PLATE 43), and La Punta, region of Callao, Jan. 25, 1907, *Coker 38 p.p.*; also on some of the original specimens of *G. disciplinalis* (from Cape Horn, Concepcion, etc.) in herb. Bory, now preserved in the Muséum d'Histoire Naturelle of Paris. The *Actinococcus* on "*Gymnogongrus vermicularis* (?)" from Callao, alluded to by Schmitz (Flora 77: 389. 1893), probably belongs here.

In size and general habit, *Actinococcus mollis* resembles *A. subcutaneus* on *Phyllophora* species fully as much as it does any of the three species described by Schmitz as parasitic on species of *Gymnogongrus*, but it differs from *A. subcutaneus* very decidedly in its softer, more gelatinous, collabent, less pedicelled, and less globose cushions, in its much smaller medullary cells (often 60–140 $\mu \times$ 30–70 μ in *A. subcutaneus*), its more elongate cells of the cortical filaments, etc.

* The cell walls are so gelatinous and confluent that it is very difficult to define their boundaries even after staining. The measurements of cells and sporangia as [h]ere given relate to their protoplasmic contents.

From *Actinococcus peltaeformis* Schmitz, *A. mollis* differs in its external cushions being more gelatinous, and hemispheric or subglobose rather than plano-convex, in protruding 0.45–1.3 mm. instead of 0.3–0.5 mm. from its host, in having an attachment base that is $\frac{1}{3}$–$\frac{4}{5}$, instead of $\frac{1}{10}$–$\frac{1}{4}$ of its horizontal diameter, in its scarcely tapering cortical filaments, in the lower and median cells of these filaments having about one half the width of the corresponding cells in *A. peltaeformis*, etc.

From *Actinococcus aggregatus* Schmitz, *A. mollis* differs in being more gelatinous and collabent, in the external cushions being hemispheric or subglobose rather than plano-convex and 0.45–1.3 mm. instead of 0.16–0.24 mm. high, in the much longer cortical filaments, in the longer and narrower cells of the cortical filaments, in the mostly narrower sporangia, etc.

From *Actinococcus latior* Schmitz,* originally described as parasitic on the South African *Gymnogongrus dilatatus*, and from the Californian plant† that has sometimes‡ been identified with *A. latior*, *Actinococcus mollis* differs so much that detailed comparisons would hardly seem necessary.

An examination of authentic material of *Actinococcus exul*

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* ACTINOCOCCUS LATIOR Schmitz, Flora **77**: 387. 1893. Cushions suborbicular to elliptic in outline, strongly convex, 1–4 mm. in diameter (0.6–1.0 mm. high), firm, closely sessile, affixed by a base ¼–⅓ as broad; cortical filaments 0.3–0.5 mm. long, usually tapering at apex, their cell protoplasts 13–19 $\mu \times$ 6–8 μ, mostly rounded at their ends and separated by hyaline intervals 3–7 μ broad; sporangia 4-parted, 28–36 $\mu \times$ 13–18 μ. On *Gymnogongrus dilatatus*, Cape of Good Hope.

† **Actinococcus Chiton** sp. nov. Cushions usually elliptic-oblong, less commonly suborbicular, 2–8 mm. long, 1–3 mm. wide, umbonate, or convex along axis with a flat spreading border, 0.65–0.85 mm. in maximum height, firm, coriaceous or subcorneous on drying, closely sessile or clasping, affixed by a base ½–⅙ as broad; cortical filaments 0.16–0.35 mm. long, scarcely tapering at apex; their cell protoplasts 8–13 $\mu \times$ 5–6 μ, with ends truncate and closely approximate, or separated by intervals 1–3 μ broad; sporangia 4-parted, 14–22 $\mu \times$ 8–11 μ. On *Gymnogongrus linearis*, California (type, Collins, Holden, & Setchell, Phycotheca Boreali-Americana *no. 1443*, issued as *Actinococcus latior* Schmitz,—in herb. N. Y. Bot. Gard.). The cushions by their elliptic-oblong outline, elevated axial parts, flat borders, and closely appressed habit, often suggest in minature certain species of molluscs of the genus *Chiton*, whence the specific name. It would appear that Gomont (Jour. de Bot. **8**: 133, 134. 1894), working with sterile material, was inclined to consider the parasite of *Gymnogongrus linearis* a new species of *Actinococcus*, and that Schmitz, to whom Gomont submitted his preparations, was even of the opinion that it might constitute the type of a new genus.

‡ Setchell, W. A. La Nuova Notarisia **16**: 59. 1905.

Pilger, described* as parasitic on *Rhodymenia* sp. from South Chile, shows that the cushions are an organic part of their supposed host, and that, with little doubt, they represent the tetrasporic nemathecia of some species of *Stenogramma*. A query on the label indicates that this possibility had already been recognized by Dr. Pilger himself.

PLATE 43. *Actinococcus mollis*

The photograph shows three or four cushions, natural size, on *Gymnogongrus disciplinalis* (*Coker 95 p.p.*—from liquid preservative).

CALLOPHYLLIS Kütz. Linnaea **17**: 102. 1843

CALLOPHYLLIS CHILENSIS (J. Ag.) Okam. Alg. Jap. Exsicc. 12. 1899. (Excluding specimen)

Microcoelia chilensis J. Ag. Sp. Alg. 3^1: 227. 1876.

Attached to *Rhodymenia corallina* in beach drift, La Punta, region of Callao, January 25, 1907, *Coker 30 p.p.* (PLATE 32, FIGURE B); three tetrasporic plants, the largest 10 cm. in maximum width.

The specimen described by J. Agardh was collected on the shores of Chile by W. H. Harvey and according to Agardh was "Nomine Kallymeniae a Harveyo inscripta." We have seen only a photograph of J. Agardh's actual type, which was cystocarpic, but, through the courtesy of the officials of the Royal Botanic Gardens, Kew, we have been able to make a microscopic examination of both tetrasporic and cystocarpic specimens of a "Kallymenia" collected by Harvey in Chile and agreeing essentially with J. Agardh's description of *Microcoelia chilensis*. From these data and from J. Agardh's excellent description, we feel justified in considering Dr. Coker's specimens to be young small thin tetrasporic individuals of the remarkable species for which the generic name *Microcoelia* was proposed.

The following description applies only to Dr. Coker's plants, but could probably be made to hold true of the species as a whole by a few modifications, such as allowing a greater thickness for the thallus, greater dimensions for the large medullary cells, etc.:†

* Hedwigia 48: 178. *pl. 7. f. B (1–5)*. 1908.

† In the plants at Kew referred to above the thallus is 320–500μ thick and the large medullary cells measure 165–320$\mu \times$65–170μ.

Sessile, subpeltate, or irregularly cordate at base, with an attachment callus about 1 mm. broad, irregularly lacerate to about the middle into a few (3–5) main divisions, these somewhat crenately margined or again irregularly lobed, the sinuses bullate-undulate; thallus gelatinous-membranous, 150–240 μ thick; medulla very gelatinous and hyaline, appearing under ordinary treatment to consist of small elongate, trigonous, or substellate cells sparingly scattered through a transparent homogeneous jelly, but after staining (i. e. with haematoxylin) seen to consist of large cells, mostly 55–257 $\mu \times$ 40–106 μ, in 1–3 irregular series, subvacuous or with tenuous almost imperceptible protoplasts and large vacuoles and with very thick more or less confluent gelatinous walls, small cells and slender filaments appearing here and there in the interstices; subcortex of two or three series of outwardly gradually smaller cells; cortex proper about two cells thick, the protoplasts of the superficial cells 4–8 μ in longest (usually vertical) diameter, 1–2 times as long as broad, usually two from each subjacent cell, mostly separated by hyaline intervals 3–8 μ broad; sporangia scattered in subcortex, 24–33 $\mu \times$ 13–17 μ (excluding gelatinous walls). [PLATE 32, FIGURE B.]

PLATE 32, FIGURE B. *Callophyllis chilensis*

Photograph of an apparently young tetrasporic specimen (*Coker 30 p.p.*—from liquid preservative), natural size.

Okamura's Alg. Jap. Exsicc. no. 12, issued as "*Callophyllis* (*Microcoelia*) *chilensis* (J. Ag.)," is, we believe, a specifically different plant, being in structure close to typical *Callophyllis*, though it appears to have enough in common with *Microcoelia chilensis* to make it difficult to maintain *Microcoelia** as a genus. The thallus of the Japanese plant is less crenate-margined and is much firmer, and less gelatinous than that of the Chilean and the Peruvian plants; the large cells of the medulla are comparatively firm-walled and are readily visible when sections are made, mounted in water, and examined under the microscope in the ordinary way; the small-celled intercalating filaments are more numerous and more conspicuous; the cortex is thicker and much firmer and the surface cells average considerably smaller.

* In connection with the possible recognition of this genus, it may be remarked that the name *Microcoelia* J. Ag. (1876) is a homonym of *Microcoelia* Lindl. (1830) and is accordingly invalid under the provisions of the "American Code" of nomenclature. There seems to be a possibility also that an application of the "Vienna Rules" may result in the recognition of *Microcoelia* Lindl. as the legal name of the genus of orchids currently known as *Mystacidium* Lindl. (1836).

The soft gelatinous character of the thallus of this South American plant and, more particularly, the remarkably soft gelatinous nature of the walls of the large cells of the medulla, which, with the equally remarkable diaphanous character of their protoplasts, renders these large cells almost invisible when examined in the usual way, seem to be about the only characters on which *Microcoelia* could be segregated as a genus.* Like the plant described by J. Agardh, Dr. Coker's specimens adhere very firmly to paper when dried under pressure.

* Of interest and importance in considering the claims of the *Microcoelia* group to generic recognition is the Chilean plant described by Montagne (Ann. Sci. Nat. Bot. III. **18**: 318. 1852) as *Callymenia sanguinea*—a species that under the Schmitzian conception of the limits of the genus *Callophyllis* should be known as **Callophyllis sanguinea** (comb. nov.). The tetrasporic and cystocarpic originals of this we have been able to see through the courtesy of M. Hariot of the Muséum d'Histoire Naturelle of Paris. They are plants that in general habit might easily pass for a *Callymenia*, but in structure are very close to J. Agardh's *Microcoelia chilensis*. The thallus is rather thicker (350–500 μ in tetrasporic plant; 450–1000 μ in cystocarpic plant) than that of *Microcoelia chilensis*, is more cartilaginous-coriaceous and corrugated when dry, and apparently does not adhere to paper. In section the medulla shows large, very thick-walled cells in 1–3 irregular series, surrounded by the much smaller cells of the intercalating filaments. The large cells, including their gelatinous walls, are, in a section, mostly 80–420μ × 50–250μ; the protoplast, in these large cells, is commonly much flattened when a section of the dried specimen is soaked out in water, and the measurements as given, of the width at least, are derived chiefly from the swollen walls. The protoplasts of the cells of the intercalary filaments are densely granular and vary in form from ovoid to long-subcylindric, with triangular-prismatic and various irregular forms also occurring; they are mostly 16–40μ long and 3–15μ wide. The soft thick hyaline walls of the large medullary cells and their thin flattened protoplasts might, in themselves, easily cause these cells to be overlooked if it were not for the fact that their outer boundaries are distinctly marked by the granular protoplasts of the circumambient filaments. The existence of these large cells is thus obvious at once on examining a section prepared in the ordinary way, while in Dr. Coker's younger softer specimens of *Microcoelia chilensis* the demonstration of their existence requires the most searching scrutiny or the use of artificial stains. The cortex proper of *Callophyllis sanguinea* is made up of short di-trichotomous filaments 2–4 cells long. The sporangia (or their protoplasts) are 30–38μ × 14–22μ and their four spores are irregularly paired.

It is possible that a more extended series of specimens than is now available might show that *Microcoelia chilensis* J. Ag. should be considered a synonym of *Callymenia sanguinea* Mont., but the thallus of Montagne's plant appears considerably more rigid and shows certain differences in external form and for the present we hardly feel justified in assuming that all of these specimens are to be referred to a single species.

CALLOPHYLLIS VARIEGATA (Bory) Kütz. Phyc. Gen. 401. *pl. 69. f. 11.* 1843; Tab. Phyc. **17**: *pl. 86.* 1867

Halymenia variegata Bory, Voy. Coquille, Bot. Crypt. 179. *pl. 14.* 1828.

Rhodomenia glaphyra Suhr, Flora **22**: 69. 1839.

Halymenia glaphyra Suhr, loc. cit. *pl. 3. f. 43.*

This species, common on the shores of Chile, appears not to have been collected in Peru by Dr. Coker, but it was figured from Peru by Suhr under the name *Halymenia glaphyra*. There is also a small specimen of it (see PLATE 55) in the Muséum d'Histoire Naturelle of Paris, attached to the type specimen of *Delesseria peruviana* Mont., collected at Callao by d'Orbigny. The species was founded by Bory on specimens collected in New Guinea by Lesson and at Concepcion, Chile, by d'Urville. The former, having precedence in citation and precedence also among the figures on Bory's plate, may be considered the technical type of the species. We have not examined the original specimens.

Family RHODOPHYLLIDACEAE

AGARDHIELLA Schmitz, Flora **72**: 441. 1889

AGARDHIELLA TENERA (J. Ag.) Schmitz, loc. cit.; in Engler & Prantl, Nat. Pflanzenfam. 1^2: 371. *f. 222E.* 1896. Setch. & Gard. Univ. California Publ. Bot. **1**: 309. 1903

Gigartina tenera J. Ag. Linnaea **15**: 18. 1841.

Gigartina Gaudichaudii Mont. Ann. Sci. Nat. Bot. II. **18**: 255. 1842; Voy. Bonite, Bot. Crypt. 69. *pl. 143. f. 1.* 1846.

Trematocarpus virgatus Kütz. Phyc. Gen. 411. 1843; Tab. Phyc. **19**: 27. *pl. 72. f. c, d.* 1869.

Cystoclonium Gaudichaudii Kütz. Bot. Zeit. **5**: 22. 1847; Tab. Phyc. **18**: *pl. 15. f. b, c.* 1868.

Sphaerococcus tuberculosus Hampe; Kütz. Sp. Alg. 773. 1849; Tab. Phyc. **18**: 27. *pl. 77. f. a.* 1868.

Sphaerococcus tener Kütz. Sp. Alg. 777. 1849.

Rhabdonia tenera J. Ag. Sp. Alg. **2**: 354. 1852; Osterhout, Ann. Bot. **10**: 403–427. *pl. 20, 21.* 1896.

Gracilaria tuberculosa J. Ag. Sp. Alg. **2**: 588. 1852.

Solieria chordalis Harv. Ner. Bor.-Am. 2: 121. *pl. 23A.* 1853. Not J. Ag. 1842.

Rhabdonia Coulteri Harv. Ner. Bor.-Am. 2: 154. *pl. 23B.* 1853.

Cystoclonium gracilarioides Harv. Jour. Linn. Soc. 6: 171. 1862.

Rhabdonia Baileyi Harv.; Kütz. Tab. Phyc. 16: 26. *pl. 74. f. c, d.* 1866.

Agardhiella Coulteri Collins, Holden & Setchell, Phyc. Bor.-Am. 333. 1897.

In beach drift, Ancón, Feb. 13, 1907,—a tetrasporic plant—*Coker 94* (PLATE 47); "dredged in about five fathoms," Bay of Sechura, Apr. 8, 1907,—a single sterile plant—*Coker 157 p.p.* The species, under the name *Rhabdonia Coulteri*, has been reported by Piccone* from the Island of San Lorenzo, near Callao; under the name *Gigartina Gaudichaudii* from Paita, by Montagne (loc. cit.). *Trematocarpus virgatus* Kütz. and *Sphaerococcus tuberculosus* Hampe were attributed to Peru without definite locality.

The larger of the two plants collected by Dr. Coker is sterile and 45 cm. long and in habit suggests some of the larger conditions of *Gracilaria confervoides*. The shorter tetrasporic plant (shown in our photograph—PLATE 47) is stouter and has more of the ordinary habit of the plant of the Atlantic coast of North America and of the plant of the Pacific North American coast that has long been known as *Rhabdonia Coulteri* or *Agardhiella Coulteri*, though rather recently identified with *A. tenera* by Setchell and Gardner. We have seen cystocarps of the Peruvian plant only in the type specimens of *Trematocarpus virgatus* Kütz. and *Sphaerococcus tuberculosus* Hampe, which we have examined through the courtesy of Mme. Weber-van Bosse, and in the type specimen of *Gigartina Gaudichaudii* Mont., for the sight of which we are indebted to the authorities of the Muséum d'Histoire Naturelle of Paris. The type of *G. Gaudichaudii* has been much flattened by pressure. The three names last mentioned now appear in the synonymy of *Agardhiella tenera* for the first time so far as we know. The large interior cells of the thallus of the Peruvian plants average somewhat smaller than the corresponding cells in North American specimens, their walls are rather thinner, and the medullary hyphae, as well shown in Kützing's figure (Tab. Phyc. 19: *pl. 72. f. d.*),

* Alg. Vettor Pisani 78. 1886.

commonly form a more solid or compact central strand than in the ordinary North American conditions of the species. We have not been able to examine the structure of the procarp in these Peruvian plants, but the general habit of the plants and the distribution of the cystocarps seem to justify placing them with *Agardhiella* rather than with *Solieria*.

The type of *Cystoclonium gracilarioides* Harv. from Esquimalt Harbor, British Columbia, we saw in 1904 in the herbarium of Trinity College, Dublin, and considered it to be "*Rhabdonia Coulteri*," but we have no detailed notes and no recollection of any microscopic study of it. It was described by Harvey as sterile.

PLATE 47. *Agardhiella tenera*

Photograph of a tetrasporic specimen (*Coker 94*—from liquid preservative), natural size.

Rissoella ? denticulata (Mont.) J. Ag., described from Paita, Peru, is discussed under *Grateloupia*, the genus in which it was originally placed by Montagne.

Family SPHAEROCOCCACEAE

TREMATOCARPUS Kütz. Phyc. Gen. 410. 1843

TREMATOCARPUS DICHOTOMUS Kütz. Phyc. Gen. 410. *pl. 51. f. I.* 1843; Tab. Phyc. 19: *pl. 72. f. a, b.* 1869

Thallus cartilaginous, compressed or complanate throughout, flabellately dichotomo-fastigiate, attaining a length of about 11 cm. and commonly 8 or 9 times forked, reddish toward the apices but mostly a light olive-green, occasionally proliferous toward the base; segments linear, erecto-patent, 1.5–3 mm. wide, 2–4 times as wide as thick, often lightly canaliculate, the axils somewhat rounded, the apices subacute or rather obtuse, the longer sometimes lanceolate; medulla rather loosely filamentous; peripheral cells of cortex 5–10 μ in diameter in surface view; nemathecia on one face only, rather indefinite in form, sometimes occupying the entire face of the segment, sometimes limited to a narrow longitudinal band; tetrasporangia zonately divided, the spore-tetrads 58–72 $\mu \times$ 16–24 μ; cystocarps marginal or irregularly aggregated, subglobose, about 1 mm. in diameter. [PLATE 48.]

In "one fathom," Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09641* (PLATE 48).

This species was based on a Peruvian specimen sent to Kützing by Bartling, with which, through the courtesy of Mme. Weber-van Bosse, we have been able to compare Dr. Coker's plant. Kützing's first-published figure of the structure of the plant is more accurate and less schematic than his later one, but both figures of the cystocarp in section give the impression that the spores are in rather more regular and more elongate concatenate rows than they really are. The few cystocarps that occur on Dr. Coker's specimens are somewhat immature and each of the sporogenous filaments terminates in a long-clavate cell, from the apex of which the spores are abjuncted. In the more mature cystocarps studied by Kützing the spores adhere in irregular rows of 2–4. The sporogeneous filaments are more numerous and crowded than might be inferred from Kützing's figures and the medulla of the thallus is commonly less homogeneous and more loose and vacuous.

Dr. Coker's plants are essentially tetrasporic, and it may be of especial interest in connection with the "alternation of generations" which has recently been shown to characterize so many of the Florideae, to remark that the only cystocarps seen by us occur on a proliferation from a tetrasporic plant.* It may naturally be suggested that this proliferation owed its origin to the germination of a tetraspore *in situ*. However, the same proliferation bears also a few sporangia, even on the wall of one of the cystocarps, but these sporangia have an abnormal appearance, being commonly undivided, once divided, or irregularly divided; in only one sporangium on this proliferation, have we noted the normal zonate division. Elsewhere, in our material, the sporangia are very regularly divided into the four spores in the zonate fashion.

PLATE 48. *Trematocarpus dichotomus*

Photograph of a tetrasporic specimen (*Coker 09641*—from liquid preservative), natural size.

Trematocarpus virgatus Kütz., described from Peru, appears to be referable to *Agardhiella tenera*, q. v.

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* Compare Rigg, G. B., & Dalgity, A. D. A note on the generations of *Polysiphonia*. Bot. Gaz. 54: 164, 165. *f. 1.* 16 Au 1912. Also Harvey-Gibson, R. J., & Knight, M. Reports on the marine biology of the Sudanese Red Sea.—IX. Algae (Supplement). Jour. Linn. Soc. Bot. 41: 307, 308. Jl 1913. And Svedelius, N. Über Sporen an Geschlechtspflanzen von *Nitophyllum punctatum;* ein Beitrag zur Frage des Generationswechsels der Florideen. Ber. Deuts. Bot. Ges. 32: 106–116. *pl. 2 + f. 1.* 1914.

GRACILARIA Grev. p.p. Alg. Brit. liv, 121. 1830

Ceramiantemum Donati, Auszug Natur-Geschichte Adriat. Meers 26. 1753.
Ceramion Adans. Fam. Pl. 2: 13. 1763.
?*Plocaria* Nees, Hor. Phys. Berol. 42. 1820.

GRACILARIA PERUANA Picc. & Grun.; Piccone, Alg. Vettor Pisani 70. 1886

This apparently was not met with by Dr. Coker. The original material came from Paita. Notes on an authentic specimen were published in Bull. Torrey Club 38: 505. 1911.

Gracilaria multipartita (Clem.) J. Ag. has been attributed to Paita, Peru, by Montagne (Voy. Bonite, Bot. Crypt. 107. 1846) under the name *Rhodymenia multipartita*. We have not seen Montagne's material, but suspect that it belongs with *G. peruana* Picc. & Grun., which was described from the same locality.

Gracilaria corticata J. Ag., originally described from Ceylon has been reported by Grunow (Novara Exped. Bot. 1: 83. 1867) as having been collected in Peru by Philippi.

Gracilaria tuberculosa (Hampe) J. Ag. (*Sphaerococcus tuberculosus* Hampe), described from Peru, appears to be referable to *Agardhiella tenera*, q. v.

HYPNEA Lamour. Essai 43. 1813

Hypnophycus Kütz. Phyc. Gen. 404. 1843.

HYPNEA MUSCIFORMIS (Wulf.) Lamour. loc. cit.

Fucus musciformis Wulf. in Jacq. Collect. 3: 154. *pl. 14. f. 2.* 1789.
Sphaerococcus musciformis Ag. Sp. Alg. 1: 326. 1822.

"In the surf," Lobos de Tierra, April 2, 1907, *Coker 151 p.p.*; from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*

The specimens consist of small fragments only, but they seem to fit well in *Hypnea musciformis*, so far as may be determined from the material available. The species was reported from Callao by Montagne under the name *Sphaerococcus* (*Gigartina*) *musciformis* (Fl. Boliv. 30. 1839) and has more recently been attributed to Pisco by Pilger (Hedwigia 48: 180. 1908).

Sarcodia ? limensis (Sond.) De-Toni, described from Peru, is discussed under *Sebdenia*.

Family RHODYMENIACEAE

RHODYMENIA Grev. Alg. Brit. xlviii, 84. 1830
[As *Rhodomenia*]

Palmaria Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 54, 69. 1809. Not *Palmaria* Stackh. Ner. Brit. xxxii. 1801. Not *Palmaria* Web. & Mohr, Beitr. Naturk. **1**: 300. 1805.

RHODYMENIA FLABELLIFOLIA (Bory) Mont. Voy. Bonite, Bot. Crypt. 105. 1846

Sphaerococcus flabellifolius Bory, Voy. Coquille, Bot. Crypt. 174. *pl. 17.* 1828.

"In the surf, common," Lobos de Tierra, Apr. 2, 1907, *Coker 148* (PLATE 49); "taken from the stomach of a green turtle," Lobos de Afuera, March 25, 1907, *Coker 146 p.p. max.*; "dredged in about 5 fathoms," Bay of Sechura, Apr. 8, 1907, *Coker 157 p.p.*; "taken from a net fished in 1–3 fathoms, purplish," Ballestas Islands, region of Pisco, *Coker 478*.

The mature specimens obtained by Dr. Coker attain a height of 25–30 cm. No. 478 is rather sparingly cystocarpic; cystocarps subglobose or hemispheric, 0.66–0.83 mm. in diameter, obtusely subapiculate or with a sort of crown 0.16–0.32 mm. high and 0.32 mm. broad.

The original specimen of *R. flabellifolia* was collected at Concepcion, Chile, by d'Urville in 1823. The species has been reported from Peru by Montagne (loc. cit.) and by Piccone (Alg. Vettor Pisani 63. 1886).

PLATE 49. *Rhodymenia flabellifolia*

Photograph of a sterile specimen (*Coker 148*—from liquid preservative), reduced to a little less than two fifths of the natural dimensions.

RHODYMENIA CORALLINA (Bory) Grev. Alg. Brit. xlviii. 1830

Sphaerococcus Palmetta, ε *australis* Ag. Sp. Alg. **1**: 246. 1822.
Sphaerococcus corallinus Bory, Voy. Coquille, Bot. Crypt. 175. *pl. 16.* 1828.
?*Sphaerococcus palmettoides* Bory, loc. cit. 173.

In beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 29* (PLATE 50); also *30 p.p.* (cystocarpic, PLATE 51) and *31*, same

locality and date; brought up on a fish-hook from six fathoms, Bay of Pacasmayo, Mar. 14, 1907, *Coker 123 p.p.* (fragments); "in the surf, red, common," Lobos de Tierra, Apr. 2, 1907, *Coker 149a,* "dredged in about 5 fathoms," Bay of Sechura, Apr. 8, 1907, *Coker 157 p.p.*

The best-developed specimens secured by Dr. Coker attain a length or height of 15–25 cm. Nos. 30 and 31 are cystocarpic; cystocarps scattered or aggregated on both faces and occasionally on the margins, conico-hemispheric or mammiform, 0.65–0.85 mm. in diameter, not at all apiculate or coronate.

We have not seen the type of *Sphaerococcus palmettoides* Bory, described from Paita, but from Bory's description we believe it to be much like Coker's 149a, which we are referring to *R. corallina*.

The type of *Rhodymenia corallina*, like that of *R. flabellifolia*, was collected at Concepcion, Chile, by d'Urville in 1823, though Bory, at the time of the original publication, referred to fragments from Paita, Peru, as probably belonging to the same species. It has been reported from Callao by Humboldt, Bonpland, and Kunth (Nov. Gen. et Sp. Pl. 418. 1825, as *Sphaerococcus Palmetta*) and by Montagne (Fl. Boliv. 29. 1839) and from Paita by Piccone (Alg. Vettor Pisani 63. 1886).

PLATE 50. *Rhodymenia corallina*

Photograph of a dried and pressed sterile specimen (*Coker 29*), reduced to a little less than three fifths of the natural dimensions.

PLATE 51. *Rhodymenia corallina*

Photograph of a cystocarpic specimen (*Coker 30 p.p.*) from liquid preservative, reduced to a little more than one third of the natural dimensions.

Rhodymenia flabellifolia and *R. corallina* are apparently very distinct species, yet sterile decolorate fragments are sometimes difficult to determine. *Rhodymenia flabellifolia* has a greater development of the subterete stipe, axis, or "stem," which is almost percurrent; the plants probably stand rather rigidly erect when growing. In *R. corallina*, the subterete stipe is commonly and typically only 0.5–4.0 cm. long and the plants are probably subdecumbent, or cespitose and weakly erect, when growing; yet sometimes, if our conception of the species is correct, in decumbent encrusted forms (*Coker 30 p.p.*) the subterete axis and its branches may be much prolonged and may be almost as percurrent as in *R.*

flabellifolia. In *R. flabellifolia* the main axes, after a few dichotomies near the base, bear numerous rather short lateral irregularly alternate or multifarious flabellately dichotomous often contorted or crisped foliar expansions, many of which have the habit of innovations or proliferations. In *R. corallina*, the thallus is, on the whole, except for occasional proliferations, plane and consistently dichotomous. In *R. flabellifolia* the cystocarps are somewhat apiculate or subcoronate; in *R. corallina* the cystocarps, so far as we have observed, bear no trace of an apiculum or crown. From published descriptions and from Dr. Coker's field notes it would appear that plants of the two species differ in color, *R. flabellifolia* being purplish, while *R. corallina* is coralline-red, but in our fluid-preserved material this distinction is hardly perceptible.

RHODYMENIA PERUVIANA J. Ag. (Sp. Alg. **2**: 378. 1852), a photograph (FIGURE 40) of the original of which we owe to the courtesy of Professor Nordstedt, was apparently not collected by Dr. Coker. This is a plant of the general habit of *R. palmata*—a plant with broader segments and fewer dichotomies than *R. corallina*. The original specimen is about 16.5 cm. long and its segments are 0.75–2.25 cm. broad. It is said to have come from the southern shores of Peru, and it possibly does not occur within the present limits of the country.

Rhodymenia chiloensis Mont.* ("*chilensis*" of J. Ag. and of De-Toni), described from the island of Chiloe, is cited as a synonym of *R. corallina* by De-Toni (Syll. Alg. **4**: 516. 1900), but this is evidently an error. *Rhodymenia chiloensis* is described by Montagne as having the structure of *R. Hombroniana* and *R. Hombroniana* manifestly belongs to *Callophyllis*, as is now generally recognized. Photographs of the original specimens of *R. chiloensis* we have been able to examine through the courtesy of Professor Mangin and M. Hariot of the Muséum d'Histoire Naturelle in Paris. The plants have the habit of a *Callophyllis* and obviously have nothing to do with *Rhodymenia corallina*. The original specimens vary greatly in size and width of the segments of the thallus, the plants ranging in length from about 7 cm. to 28 cm. and

* Ann. Sci. Nat. Bot. III, **18**: 316. 1852; also in C. Gay, Hist. Fis. y Pol. Chile Bot. **8**: 300. 1852.

the main segments ranging in width from 2 mm. to 24 mm. They are, apparently, to be compared with the less dissected forms of *Callophyllis variegata*.

The original of *Rhodymenia centrocarpa* Mont. (Ann. Sci. Nat.

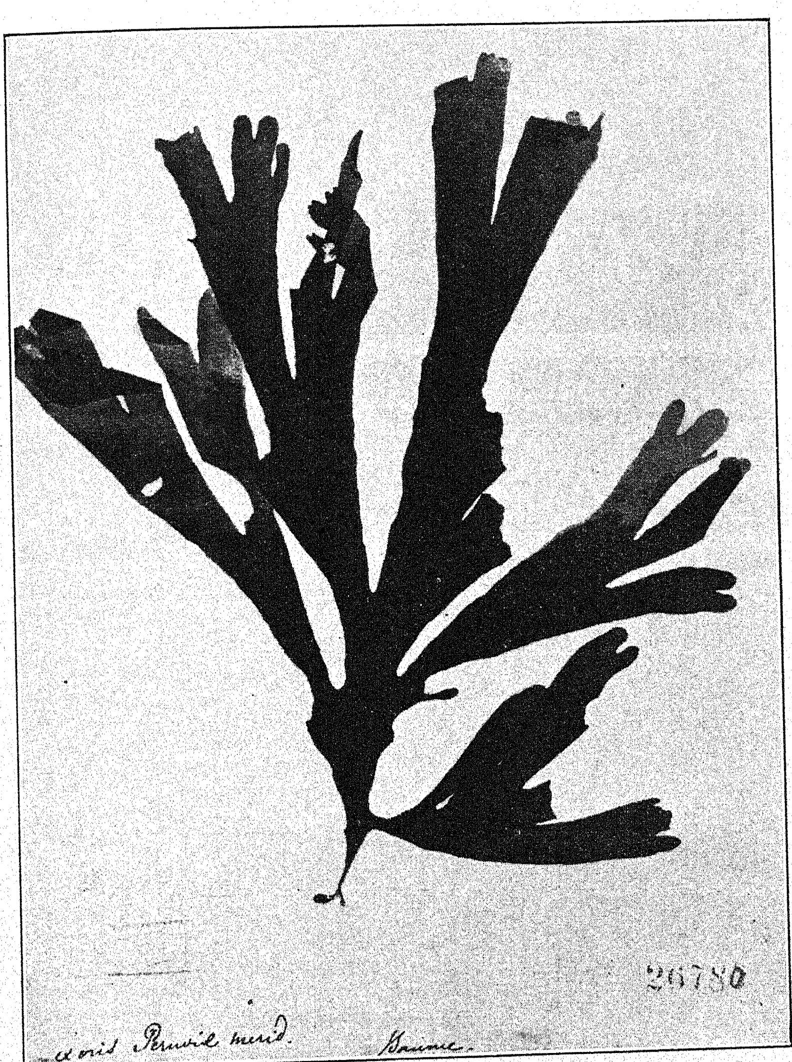

FIGURE 40. A photograph of the original specimen of *Rhodymenia peruviana* J. Ag. "ex oris Peruviae merid." (*no. 26780* in herb. Agardh), about three fifths of the natural dimensions.

Bot. III. 18: 316. 1852) is apparently not to be found in the herbarium of the Muséum d'Histoire Naturelle of Paris, but this also is probably a *Callophyllis*, for the parenthetical subgeneric or sectional name "Calliphyllis" was used by Montagne and comparison was made with the plant now known as *Callophyllis laciniata*. Under the name of *Sphaerococcus* (*Rhodymenia*) *laciniatus* var. *centrocarpus* (Mont. Fl. Boliv. 28. 1839) the plant was originally attributed to Callao, but in Montagne's later references to it (loc. cit. and in C. Gay, Hist. Fis. y Pol. Chile Bot. 8: 302. 1852, and Mont. Syll. Crypt. 414. 1856) Valparaiso, Chile, replaces Callao, Peru.

CORDYLECLADIA J. Ag. Sp. Alg. 2: 702. 1852; 3^1: 326. 1876

Cordylecladia lemanaeformis (Bory) comb. nov.

Gigartina lemanaeformis Bory, Voy. Coquille, Bot. Crypt. 151. 1828.

Cordylecladia Andersonii Grun. p. p.; Piccone, Alg. Vettor Pisani 62. 1886.

In beach drift, Chimbote, February 27, 1907, *Coker 108 p.p.*, (sterile), with *Desmarestia peruviana*.

The type specimen of *Gigartina lemanaeformis* Bory was collected at Paita, Peru, by d'Urville in 1823 (PLATE 52). It has been referred by Hariot* to *Gracilaria lichenoides* and the original specimen in the herbarium of the Muséum d'Histoire Naturelle at Paris is thus labeled in the hand of Bornet. The plant is, however, little branched and is more slender and less rigid than specimens ordinarily referred to *G. lichenoides* and seems to us to have more the habit of *G. confervoides*. But the structure of the cystocarps and more especially the character of the placentation appear to us to be that of *Cordylecladia* rather than that of *Gracilaria*. D'Urville's specimen is thickly covered with more or less confluent cystocarps, which are mostly immature, hemispheric-mammiform, subglobose, or ovoid, and 0.35–0.63 mm. in diameter; in section they show a small basal placenta and a conglobate mass of small carpospores.

* Miss. Sci. Cap Horn 5: 70. 1889.

Cordylecladia Andersonii Grun. ("Habitus Gracilariae confervoidis, cystocarpia Cordylecladiae") was based on Californian specimens collected by Anderson and on specimens from Peru. In the place of original publication (loc. cit.) a plant from Paita,* the type locality of *Gigartina lemanaeformis*, is mentioned. The Californian plant collected by Anderson may, we think, be fairly considered the type of *C. Andersonii* and we believe it to be specifically different from the Peruvian plant, having larger, more scattered, more flattened-globose cystocarps, a habit much less like that of *Gracilaria confervoides*, and other differentiating characters. The "cystocarpis magnis" of Grunow's description we believe to have been drawn chiefly from the Californian specimens, though the "obconicis" of the "late obconicis" is hardly applicable to any of the cystocarps that we have seen, Californian or Peruvian, and we have had access to the Californian Cordylecladias of the Anderson herbarium, now in the possession of the New York Botanical Garden.

Coker's no. 108, from Chimbote, is sterile and its identification with *Cordylecladia* is open to some doubt, but certain peculiarities in structure and in branching lead us to the opinion that it belongs here.

PLATE 52. *Cordylecladia lemanaeformis*

A photograph of the type specimen of *Gigartina lemanaeformis* Bory (Paita, Peru, *d'Urville*), in the herbarium of the Muséum d'Histoire Naturelle of Paris, natural size.

CHRYSYMENIA J. Ag. Alg. Med. et Adriat. 105. 1842

Chrysymenia (?) **lobata** sp. nov.

Plane, thin-membranous, gelatinous, suborbicular or oblong in general outline, 14–24 cm. (more or less) broad, subpalmately lobed, the lobes oblong-lanceolate or plane-digitiform, broadest at base and tapering gradually to apex, obtuse, mostly 3–10 cm. long and 1–4 cm. broad at base, the larger again lobed in a similar way, the margins otherwise subentire or here and there obtusely dentate or minutely lobulate, the surface plane and smooth; thallus mostly 65–110 μ thick; medulla somewhat vacuous,

* A fragment of this (leg. *A. Marcacci*, July 1883), from the Piccone herbarium, we owe to the courtesy of Dr. Achille Forti of Verona. Its cystocarps are larger and less crowded than in the plant of d'Urville and Bory, sometimes apparently exceeding 1 mm. in diameter, but the larger sometimes owe their apparent size to confluence.

traversed by a few filaments 3–6 μ in diameter, their cells mostly 20–100 μ long, with granular contents or subvacuous, the filaments passing distally into the pyriform, fusiform, clavate, or ellipsoid cells of the subcortex, these cells mostly 15–50 μ × 11–19 μ, lying rather loosely in one or two strata, with their long axes parallel to the surface and with dense granular contents; cortex firm, 1 or 2 cells thick, the superficial cells 11–20 μ high (including 3–4 μ of surface jelly), 1–2 times as high as broad, their protoplasts in surface view angular or angular-orbicular, 5–13 μ in maximum diameter, separated by hyaline intervals 2–5 μ broad; tetrasporangia sparingly scattered, 14–27 μ × 14–17 μ, the spores "cruciate," or irregularly paired. [PLATE 53; TEXT FIGURE 41.]

Dredged on a "mud bottom, 9 fathoms," Ancón Bay, Feb. 13, 1907, *Coker 90 p.p.*—a single tetrasporic plant or part of a plant, without base.

The present species apparently belongs in the *Cryptarachne* section of *Chrysymenia*, standing nearest to the Floridian *C. planifrons* (Melv.) J. Ag. and *C. Curtissiana* J. Ag. in general habit, but in structure more like the New Zealand *Chrysymenia* (?) *apiculifera* J. Ag. In the small size of the subcortical cells and in their dense granular protoplasts, it departs rather widely from these Floridian species and from *C. ventricosa* (Lamour.) J. Ag., the Mediterranean and Adriatic type of the genus, yet is, in these respects, not far from *C.* (?) *apiculifera*. It differs, however, from the New Zealand plant very decidedly in its much larger size, the thinner less dissected thallus, with fewer, longer, and broader lobes, the absence of processes from the disc, etc. The thallus of *Chrysymenia* (?) *lobata* is not remarkably lubricous, but it is very thin and soft and adheres firmly to paper when dried under pressure. In its tenuity the plant is, in fact, quite *Porphyra*-like. In its thin gelatinous thallus it suggests also certain Pacific North American plants that have been referred by American phycologists to the genus *Aeodes* J. Ag. but its structure is different from that of J. Agardh's New Zealand type of this genus.

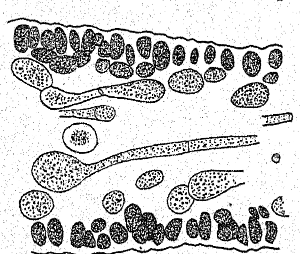

FIGURE 41. *Chrysymenia* (?) *lobata*. A cross section through the thallus, enlarged 345 diameters.

PLATE 53. *Chrysymenia* (?) *lobata*

A photograph of the dried and pressed type specimen (*Coker 90 p.p.*), reduced to a little less than two thirds of the natural dimensions.

Champia lumbricalis (Roth) Lamour., a Cape of Good Hope species, was once attributed to Peru by J. Agardh (Sp. Alg. **2**: 371. 1852), but he afterwards (Sp. Alg. 3^1: 307. 1876) omitted the Peruvian reference, and De-Toni (Syll. Alg. **4**: 564. 1900) cites Peru with an interrogation mark. Nothing of this genus was found in Dr. Coker's Peruvian collections.

Family DELESSERIACEAE

NITOPHYLLUM Grev.* Alg. Brit. xlvii, 77. 1830

Scutarius Rouss. p.p. Fl. Calvad. 91. 1806 [ed. 2].

Papyracea Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 56, 76. 1809.

Dawsonia Lamour. p.p. Dict. Class. Hist. Nat. **5**: 367. 1824. Not *Dawsonia* R. Br. Trans. Linn. Soc. **10**: 316. 1811.

Hymenena Grev. loc. cit. xlviii.

Aglaophyllum Mont. Fl. Boliv. 33. 1839.

Aeglophyllum Kütz. Linnaea **17**: 106. 1843; Phyc. Gen. 442. 1843.

Schizoglossum Kütz. Linnaea **17**: 106. 1843; Phyc. Gen. 443. 1843.

Cryptopleura Kütz. Linnaea **17**: 106. 1843; Phyc. Gen. 444. 1843.

NITOPHYLLUM CRYPTONEURON (Mont.) De-Toni, Syll. Alg. 4: 666. 1900

Aglaophyllum cryptoneuron Mont. Ann. Sci. Nat. Bot. IV. **7**: 140. 1857.

Delesseria lacerata Mont. Fl. Boliv. 33. 1839. Not *Nitophyllum laceratum* (Gmel.) Grev.

Dredged in about five fathoms, between San Lorenzo and La Punta, region of Callao, Feb. 5, 1907, *Coker 58 p.p.*, with *Pterosiphonia dendroidea*, etc.; in the surf, Lobos de Tierra, Apr. 2, 1907, *Coker 149 p.p.*, attached to base of *Rhodymenia corallina;* dredged in about five fathoms, Bay of Sechura, Apr. 8, 1907, *Coker 157*

* This generic name is a homonym of *Nitophyllum* Necker, which, however, in all probability, will never be interpreted and revived.

p.p., attached to *Rhodymenia flabellifolia;* attached to *Corallina officinalis* on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 192 p.p.*; in one fathom, Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09640 p.p.*; from the drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.* [PLATE 54.]

Like several other species of Peruvian algae secured by Dr. Coker, *Nitophyllum cryptoneuron* seems to have been known hitherto from the original specimens only, so far as we are able to determine from published records. The type of the species, collected at Callao by d'Orbigny, is preserved in the Muséum d'Histoire Naturelle in Paris and we owe a photograph of it to the courtesy of Professor Mangin and M. Hariot. Although described with much detail by Montagne, the species, like the following, was apparently overlooked by J. Agardh in his monograph of the genus (Sp. Alg. 3^3: 17–98. 1898). De-Toni (Syll. Alg. 4: 666. 1900) gives an abridged description of it and places it among his "Species minus notae aut quoad sectionem incertae." In our opinion the species is a valid one and should be placed not far from the Californian *N. Fryeanum* Harv., which was described one year later.

All of the material collected by Dr. Coker appears to be sterile or antheridial. The "maculis pallidis oblongo-rotundis" of Montagne are manifestly the antheridial sori or the places that have been occupied by them, as was suspected by him. Parts of the thallus, in its younger stages at least, are prostrate or decumbent and bear on the ventral surface numerous multicellular hapteres, which are at first dome-shaped and afterwards elongate-cylindric with a distal expansion. The basal parts of the erect thallus are 50–160 μ (2–8 cells) thick, but the upper and chief portion of the thallus is 50–115 μ thick and more or less unistratose. In a cross section of the thallus the cells in the monostromatic parts appear somewhat columnar, being mostly 2–3 times as high as broad. The numerous slender anastomosing veinlets are usually only one cell broad; they are, however, very distinct under a compound microscope in fluid-preserved material, but are often obscure when dried material is soaked out. In size and general habit the plants suggest certain forms of *N. laceratum* and of the Californian *N. violaceum*. It is possible that the

N. violaceum reported from Peru by Piccone (Alg. Vettor Pisani 73. 1886) belongs here.

PLATE 54. *Nitophyllum cryptoneuron*

Photograph of Coker's no. 465 p.p. (dried), natural size. The light spots indicate the form and distribution of the antheridial sori.

Nitophyllum peruvianum (Mont.) comb. nov.

Delesseria peruviana Mont. Ann. Sci. Nat. Bot. II. **8**: 355. 1837. Fl. Boliv. 32. 1839.

Aglaophyllum peruvianum Mont. Ann. Sci. Nat. Bot. II. **18**: 251. 1842.

Cryptopleura peruviana Kütz. Sp. Alg. 871. 1849.

? *Delesseria phylloloma* Mont. Ann. Sci. Nat. Bot. II. **8**: 355. 1837. Fl. Boliv. 32. 1839.

? *Aglaophyllum phylloloma* Mont. Ann. Sci. Nat. Bot. II. **18**: 251. 1842.

Nothing corresponding to either "*Delesseria peruviana*" (PLATE 55) or "*Delesseria phylloloma*" (FIGURE 42) was brought from Peru by Dr. Coker and we know them only from the originals preserved in the Muséum d'Histoire Naturelle of Paris. *Delesseria peruviana* is represented there by a single tetrasporic specimen collected at Callao by d'Orbigny. Montagne's description of it is excellent with the exception of the word "nervosa." The plant has no nerves or veins that, in the dried condition, are visible to the unaided eye or with the help of a hand lens. As in some other species of *Nitophyllum*, the thallus is for the most part very thin and fragile and becomes more or less rimose or fissured on being pressed and dried, and this fissured appearance of certain parts of the thallus probably suggested the "nervosa" of Montagne's description. When soaked out and placed under a compound microscope, the cells of the thallus are seen to offer a good deal of variety in form and size and one may recognize faint suggestions of veins, slightly more pronounced, perhaps, than in the "veinless" Californian *Nitophyllum spectabile*, to which the species is evidently related. The type specimen differs, however, from the later-published, though better-known, *N. spectabile* in the more elongate stipitate base, the more deeply lobed thallus, the cuneate or tapering bases of the lobes, the smaller, less con-

spicuous elliptic sori, etc. The type is 12 cm. long, but it shows only the basal part of the broadest and probably originally the longest lobe. This remnant of the broadest lobe has a maximum width of 5 cm., while the other lobes are 1–1.5 cm. in greatest width. A midrib is recognizable only in the stipital region. The thallus is for the most part very thin and 2 or 3 cells thick, but

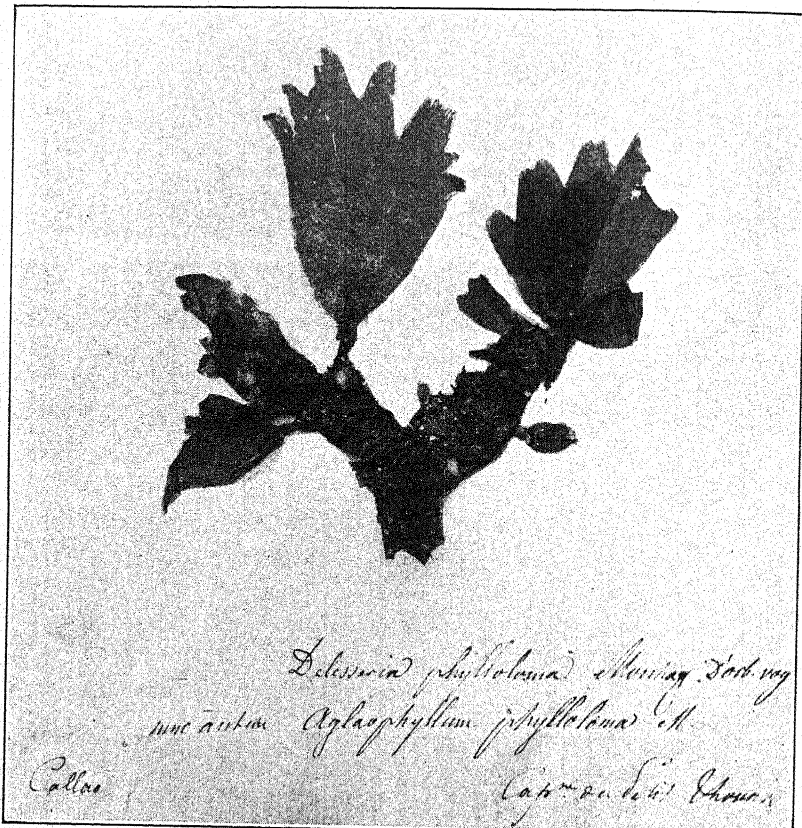

FIGURE 42. Photograph of two adherent fragments of the original material of *Delesseria phylloloma* Mont. now in the Montagne herbarium of the Muséum d'Histoire Naturelle of Paris, reduced to about four fifths of the natural dimensions.

toward the base it becomes more coriaceous and 80–110 μ (4 or 5 cells) thick. Attached to the basal part of the stipe, as shown in our photograph, is a plant of *Callophyllis variegata*.

Delesseria phylloloma Mont. is represented in the Muséum

d'Histoire Naturelle by three* cystocarpic fragments brought from Callao by du Petit-Thouars. Montagne refers to his "unique échantillon," and, though the three fragments are now mounted and inscribed as two specimens, they are so nearly identical in general habit that it is easy to suppose that they are parts of one and the same individual plant. The fragments lack basal parts, from which "*Delesseria peruviana*" draws some of its most striking characters. The thallus is nerveless and apparently ribless, as in *Nitophyllum peruvianum*, and we suspect that further collections will show that "*Delesseria phylloloma*" is a proliferous and cystocarpic condition of *Nitophyllum peruvianum*. However, there are obvious differences in form and habit as will be noted on comparing the photographs. But the apparently less deeply cleft and wider-angled forking of the apparent main segment, as shown in our photograph of "*Delesseria phylloloma*," is an illusion, due to the pressing together and adherence of two discrete pieces. The main segments appear rather more coriaceous and less adherent to paper than the probably homologous segments of "*Delesseria peruviana*," but this may be due to their more copious infection with *Endoderma viride Nitophylli*, which gives a greenish cast to all except the innovations. These main segments are 1–1.5 cm. broad and 55–95 μ (2–4 cells) thick. Cystocarps occur rather sparingly scattered both on the main segments and on the innovations; they are 0.55–0.7 mm. in diameter. The main segments show numerous perforations caused by the falling out of the cystocarps, as described by Montagne.

PLATE 55. *Nitophyllum peruvianum*

Photograph of the original specimen ("a") of *Delesseria peruviana* Mont. (Callao, *d'Orbigny*) in the herbarium of the Muséum d'Histoire Naturelle of Paris, slightly reduced. The attached plant ("b," to the left) is *Callophyllis variegata*, over the name of which the paster bearing the synonym of the *Delesseria peruviana* has to all appearances been inadvertently attached.

Nitophyllum Bartlingianum (Kütz.) J. Ag. (Sp. Alg. **2**: 656. 1852. *Schizophyllum Bartlingianum* Kütz. Phyc. Gen. 443. *pl. 69. f. I.* 1843; Tab. Phyc. **16**: *pl. 31. f. c–h.* 1866), described from the coast of Peru, was apparently not collected by Dr. Coker and we have seen no specimens of it.

* Apparently two, in reality three.

Aglaophyllum striolatum J. Ag. (Kütz. Sp. Alg. 868. 1849) was attributed to Lima by Kützing ("v. s. in herb. Binder"). We have not seen it. It is apparently not mentioned in the writings of Agardh himself. De-Toni (Syll. Alg. **4**: 661. 1900) includes it, doubtfully, in the synonymy of the South African *Nitophyllum fissum* (Grev.) J. Ag. De-Toni, by the way, attributes the name to Sonder, which may be in truth correct, although it is credited to J. Agardh in the place cited by De-Toni and where, only, the name seems to have appeared in print.

DELESSERIA Lamour.* Essai 36. 1813

Hydrolapatha Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 54, 67. 1809. Le Jolis, Mém. Soc. Imp. Sci. Nat. Cherbourg **4**: 84. 1856.

Hydrolapathum Rupr. in Middend. Reise Sibir. **1**^{2}: 250. 1850. Le Jolis, Liste Alg. Mar. Cherbourg 133. 1863. J. Ag. Sp. Alg. **3**^{1}: 369. 1876; Anal. Alg. Cont. **4**: 22. 1897.

Delesseria leiphaemia Mont. in herb. Mus. Paris., nom. nov.

Halymenia leiphaemia Mont. Ann. Sci. Bot. II. **8**: 354. 1837. Fl. Boliv. 20. *pl. 6. f. 2.* 1839.

Aglaophyllum leiphaemum Mont. Ann. Sci. Nat. Bot. II. **18**: 251. 1842. Kütz. Sp. Alg. 869. 1849.

The type of the above species is said to have been collected

* This name is untenable under modern rules of nomenclature except by arbitrary placing on a list of nomina conservanda as was done by the Brussels Congress. But inasmuch as *Delesseria* was originally based upon thirty seven species, representing several genera and several families of modern writers, it offers a good illustration of the futility of "conserving" a generic name unless it is specified for what it shall be "conserved," or, in other words, unless it is fastened to a certain species as a "type." *Delesseria sanguinea*, the first species of Lamouroux's first section of the genus, might fairly be considered the type of *Delesseria*, but this is also the evident type of *Hydrolapatha* Stackh., which (altered to *Hydrolapathum*) has been maintained as generically distinct from the other "Delesserias" by Ruprecht, Le Jolis, J. Agardh, and others. J. Agardh even maintained to the last (Anal. Alg. Cont. 4: 22–27. 1897) that its affinities were with the Rhodymeniaceae rather than with the "Delesseriaceae." There is also much difference of opinion as to the validity of other proposed segregates from the "Delesseria" of the earlier authors. We consider "Delesseria" an untenable name and one that it is undesirable to "conserve." However, the name carries a more or less obvious meaning as currently used and we employ it here, pending a more critical study of generic limits in this family.

at Valparaiso by du Petit-Thouars. In Montagne's herbarium at the Muséum d'Histoire Naturelle of Paris, attached to the same sheet with an evidently authentic specimen attributed to Valparaiso, is a pocket inscribed "*Aglaophyllum leiphaemum* Montag. Pérou, d'Orbigny" and containing on mica a small fragment which appears to have all of the peculiarities of the accompanying Valparaiso specimen, even to the encrusting diatoms, and which was, in all probability, detached from it. The species seems not to have been met with in Peru by Dr. Coker.

It was Montagne's final opinion that his *Halymenia leiphaemia* belonged to the genus now currently known as *Nitophyllum*, but this opinion we are unable to share, chiefly on account of its obvious apical cells. The plant, however, bears a certain resemblance to the Australian *Nitophyllum fallax* J. Ag., which, alone, Agardh* makes to constitute his "Tribus VII. Costatae" of the subgenus *Aglaophyllum*. The stipe of du Petit-Thouars' specimen is elliptic or lenticular in cross-section and is about 0.8 mm. broad and 0.25 mm. in greatest thickness. Its continuation forms an obvious costa in the basal parts of the thallus and faint evidences of the presence of a costa may be seen now and then, in the pressed and dried specimen, even extending into the terminal lobes, but in general the costa becomes broad, diffuse, and scarcely discernible except in a cross section. It often occupies ½–¾ the width of the segment and sometimes, by the suppression or wearing away of the marginal laminae, may constitute the whole width of the segment. The costa is mostly 4–6 cells thick, while the alar lamina is 1 or 2 cells thick. The superficial cells of the costa are of about the same size as subjacent cells, but the medullary axial cells of the costa are somewhat enlarged. The superficial cells of costa and the cells of the laminae are mostly 25–55 μ in maximum length. The thallus margins are commonly erose-crenulate, with small blunt irregular teeth. Rarely one may perceive a fairly well-defined nerve running from the margin of the costa to a marginal tooth. The teeth commonly show protuberant thick-walled apical cells, but the adjacent cells do not have the regularity of arrangement that is characteristic of the typical species of *Delesseria*. However, the young and rarely occurring pro-

* Sp. Alg. 3[3]: 48. 1898.

liferations show conspicuous hemispherical or lunate-discoid apical cells and a regularly seriate arrangement of the cells that are cut off from them. The apices of the thallus, in Montagne's specimen, are so thin, etiolated, and so crushed into the paper in mounting that we have been unable (without risking serious injury to the specimen) to obtain a view of the main apical cells. The original specimen is, we believe, sterile, the "sporidia intensius colorata" of Montagne appearing to be simply groups of cells that have retained their rose-red endochrome in the more or less etiolated apical portions of the thallus. The chromoplasts of such cells are often irregularly divided somewhat as indicated in Montagne's figure *b*.

We have received from the herbarium of the Muséum d'Histoire Naturelle of Paris a specimen of *Delesseria leiphaemia*, said to have been collected in Valparaiso, and communicated by M. R. E. Bustos of the Museo Nacional of Santiago de Chile. This specimen is of recent collection, is well preserved, and shows well the arrangement of the cells at the apices of the main lobes of the thallus. These lobes are rounded, obtuse, and neither apiculate nor emarginate. The apical cell is several times larger than those immediately adjacent and the adjacent derivative cells are in semicircular or arcuate rows. This specimen, also, appears to be sterile or perhaps shows incipient sporangia. The stipital or imperfectly alate basal portions of the thallus are longer than in the original specimen, reaching sometimes a length of 2–4 cm.

Delesseria sinuosa (Good. & Woodw.) Lamour. has been reported from San Lorenzo, in the region of Callao, by Montagne (Voy. Bonite, Bot. Crypt. 112. 1846).

Erythroglossum bipinnatifidum (Mont.) J. Ag. (Sp. Alg. 3^3: 176. 1898. *Delesseria bipinnatifida* Mont. Fl. Boliv. 31. *pl. 6. f. 1.* 1839) has been reported by J. Agardh (Sp. Alg. 2: 688. 1852) from the shores of southern Peru as well as from Chile (Valparaiso was the type locality), but it was possibly from that part of the older Peru that is now under the control of Chile. It does not occur in the collections made by Dr. Coker.

CALOGLOSSA (Harv.) J. Ag. Sp. Alg. 3^1: 498. 1876

Delesseria, sect. *Caloglossa* Harv. Ner. Bor.-Am. **2**: 98. 1853.

CALOGLOSSA LEPRIEURII (Mont.) J. Ag. loc. cit. 499. Cramer, Über Caloglossa Leprieurii, 1–18. *pl. 1–3.* 1891

Delesseria Leprieurii Mont. Ann. Sci. Nat. Bot. II. **13**: 196. *pl. 5. f. 1.* 1840. Harv. loc. cit. *pl. 22C.*

Hypoglossum Leprieurii Kütz. Sp. Alg. 875. 1849; Tab. Phyc. **16**: 5. *pl. 10. f. d–h.* 1866.

On and with oyster shells on root of *Rhizophora*, near Capón, region of Tumbes, February 1908, *Coker 359 p.p.* The specimens are sparingly cystocarpic. The cells of the thallus wing are rather larger and thinner-walled than in specimens from Cayenne, the type locality. So far as we know, this species has not before been reported from the Pacific Coast of South America.

Family RHODOMELACEAE

Laurencia glomerata Suhr (J. Ag. Sp. Alg. **2**: 753. 1852) is attributed to Callao by De-Toni (Syll. Alg. 4: 787. 1903). J. Agardh at the time of publishing the species for Suhr remarked that Suhr had distributed the species with a label inscribed "Collao," but that his plant had without doubt come from the Binder herbarium, and that Binder's plant was attributed to La Guayra and Puerto Caballo, which are on the Atlantic or Caribbean shores of South America. No *Laurencia* occurs in the Peruvian collections made by Dr. Coker.

Chondria secundata J. Ag. (Sp. Alg. **2**: 803. 1863) was originally described from the southern shores of Peru. We have not observed it in Dr. Coker's collections, but have seen a plant from Valparaiso, Chile, (*Bustos 17*, in herb. N. Y. Bot. Garden) that agrees with J. Agardh's description of the species.

POLYSIPHONIA* Grev. Fl. Edin. 308. 1824

* This is obviously not the oldest generic name for the group to which it has been almost universally applied for more than half a century, but in view of certain complications in the nomenclatural history of the genus and in view of possible future generic segregations, we prefer, for the present at least, to accept the action of the Brussels Congress in placing *Polysiphonia* in its current sense upon the list of *nomina conservanda*.

(?) *Polyostea* Donati, Auszug Natur-Geschichte Adriat. Meers 22. 1753.*

Hutchinsia Ag. Syn. Alg. Scand. xxvi. 1817. Not *Hutchinsia* R. Br. in Ait. Hort. Kew. **4**: 82. 1812.

Vertebrata S. F. Gray, Nat. Arr. Brit. Pl. **1**: 338. 1821.

Grammita Bonnem. Jour. Phys. **94**: 186. 1822. (Not seen.)

Grateloupella Bory, Dict. Class. Hist. Nat. **3**: 340. 1823; **7**: 480. 1825.

Dicarpella Bory, loc. cit. **3**: 340. 1823; **5**: 464. 1824.

Carradoria Mart. Fl. Bras. **1**: 15. 1833.

Grammitella Crouan, Ann. Sci. Nat. Bot. III. **10**: 372. 1848.

POLYSIPHONIA ABSCISSA Hook. f. & Harv. in Hook. f. Fl. Antarc. 480. *pl. 183. f. 2.* 1846. Harv. in Hook. f. Fl. Nov.- Zel. **2**: 227. 1855. J. Ag. Sp. Alg. **2**: 974. 1863. Kütz. Tab. Phyc. **13**: 22. *pl. 70. f. a–d.* 1863

Polysiphonia microcarpa Hook. f. & Harv. in Hook. f. Fl. Antarc. 479. *pl. 182. f. 3.* 1846.

In beach drift, La Punta, region of Callao, January 25, 1907, *Coker 30 p.p.* (cystocarpic); abundant in the lagoon at the mouth of the Río Rímac, region of Callao, February 4, 1907, *Coker 51 p.p.* (with a little of *P. paniculata*); dredged on muddy bottom in Ancón Bay, February 13, 1907, *Coker 90 p.p.* (with *P. paniculata*); in beach drift, Chimbote, February 27, 1907, *Coker 108 p.p.*; on *Caulerpa flagelliformis ligulata*, Lobos de Afuera, March 17 and 18, 1907, *Coker 124 p.p.* and *126 p.p.* (cystocarpic and tetrasporic); "in the surf," Lobos de Tierra, April 2, 1907, *Coker 149 p.p.*; "from estero (salt creek) known as Río Zarumilla, near Capón, six miles from ocean—density 1022–1024," February 2, 1908, *Coker 344 p.p.* (tetrasporic); from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.* (cystocarpic).

The various specimens here referred to *Polysiphonia abscissa* agree in having four pericentral siphons but offer considerable

* No species is mentioned. In this German translation of Donati's Della Storia Naturale Marina dell' Adriatico, his generic name *Poliosteo* (p. 24 of original 1750 edition) is latinized or hellenized to *Polyostea*, in which form it was adopted by Ruprecht (in Middendorff, Reise in Sibirien 1^2: 231. 1850).

diversity in size, habit, length and diameter of segments, form of cystocarps, etc., and we do not feel confident that all should be identified with a single species. The plants forming small tufts on *Caulerpa* are perhaps especially open to suspicion. Some of the specimens cited are mere fragments picked out from among other algae. The mode of branching in all of the specimens is less pinnate than indicated by the figures of *P. abscissa* published by Hooker and Harvey and by Kützing, but is on the whole not very different from that shown in Hooker and Harvey's figure of *P. microcarpa*, which species was later merged by Harvey with *P. abscissa*. The types of both *P. microcarpa* and *P. abscissa* were from the Cape Horn region. The segments in all of the specimens are rather short, perhaps averaging 1½ times as long as broad. In some (e. g., no. 90) the lower segments become 3–4 times as long as broad and show spirally twisted pericentral siphons. Hairs or "leaves" often seem to be entirely wanting, as in Kützing's figure, and in such cases the plants are more or less suggestive of *Streblocladia camptoclada*, but the segments are much longer both actually and relatively, the filaments are commonly more slender, and the apices are not recurved. The cystocarps as a rule are not conspicuously urceolate or coronate but in no. 30 they may become so, especially after the shedding of the carpospores.

Polysiphonia abscissa is closely related to *P. urceolata* (Lightf.) Grev. Harvey has remarked* of it, "The species represents *P. formosa* and *P. urceolata* in the Southern Ocean, and is probably as variable as those forms are well known to be." The shorter segments and certain not easily definable differences in habit appear to be the best characters for distinguishing the species from *P. urceolata*. The segments of the Peruvian plant are probably shorter than those of *P. abscissa* and *P. microcarpa* as originally described from the Cape Horn region. It is of interest to note that Hariot recognizes both *P. urceolata* and *P. abscissa* in his report upon the algae of the "Mission Scientifique du Cap Horn."†

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* In Hook. f. Fl. Tasm. 2: 299. 1860.
† 5: 104, 105. 1889.

POLYSIPHONIA PANICULATA Mont. Ann. Sci. Nat. Bot. II. **18**: 254. 1842; Voy. Bonite, Bot. Crypt. 91. *pl. 143. f. 2.* 1846. Kütz. Tab. Phyc. **13**: 15. *pl. 45. f. c–e.* 1863

Polysiphonia stricta? Mont. Fl. Boliv. 18. 1839. Not *P. stricta* (Dillw.) Grev.; Hook. Brit. Fl. 2^1: 329. 1833.
Polysiphonia commutata Endl. Gen. Pl. Suppl. 3: 45. 1843. Not *P. commutata* Kütz. Phyc. Gen. 428. 1843.
Polysiphonia Orbigniana Kütz. Sp. Alg. 820. 1849.

On *Gigartina Chauvinii* offered for sale in the market of Lima, Jan. 14, 1907, *Coker 26 p.p.*; in lagoon at the mouth of the Río Rímac, region of Callao, February 4, 1907, *Coker 51 p.p.*; dredged on muddy bottom in Ancón Bay, February 13, 1907, *Coker 90 p.p.*; with *Caulerpa flagelliformis ligulata* and *Polysiphonia* sp., Lobos de Afuera, Mar. 18, 1907, *Coker 126 p.p.*; in a lagoon at La Puntilla, Bay of Paracas, June 29, 1907, *Coker 09619 p.p.*

This species appears to have been rarely met with since its original collection on the shores of Peru by d'Orbigny and by Gaudichaud, but it has been reported from Paita and from the Island of San Lorenzo by Piccone.* The 9–11 pericentral siphons are often twisted or spirally disposed, as described by Montagne.

The "*Polysiphonia stricta*?" of Montagne's Florula Boliviensis has been given new names by Endlicher and by Kützing, apparently on the strength of Montagne's description without an examination of his plant. Montagne's doubtful reference of the plant to the 4-siphoned *P. stricta*, together with his description of the "articuli" as "venis quatuor striati," has naturally led subsequent writers to suppose that the plant belonged with the oligosiphonous species. However, in Montagne's original material of his "*Polysiphonia stricta?*" (Callao, *d'Orbigny*), which we have been permitted to examine through the courtesy of M. Hariot, we find only a 9–10-siphoned plant, aside from the associated 4-siphoned *Streblocladia camptoclada*, and we think the "venis quatuor striati" of Montagne's description was intended to apply only to the superficial appearance of a segment as ordinarily observed under the microscope. We cannot see that the plant

* Alg. Vettor Pisani 83. 1886.

differs from the *Polysiphonia paniculata*, described by Montagne three years later from Peruvian material collected by Gaudichaud.

The species occurs also in Chile, where it was collected by W. H. Harvey, according to a specimen placed with *P. Orbigniana* in herb. Montagne.

POLYSIPHONIA sp.

Repent, forming thin diffuse mats about 1.5 cm. (or more?) in diameter; pericentral siphons 4, ecorticate; main filaments rather sparingly radicelliferous, 65–105 μ in diameter, their segments 1¼–2 times as long as broad; branching alternate, often appearing subdistichous and loosely virgate-fasciculate toward the apices, the branches usually separated by six segments; ultimate ramuli erecto-patent or subappressed, fusiform, tapering about equally to base and apex, mostly 0.17–0.50 mm. long and 30–35 μ in maximum width, their segments shorter than broad or subequal toward base, fibrils ("hairs," "leaves") short and inconspicuous.

On *Sargassum*, Lobos de Afuera, December 5, 1907, *Coker 279 p.p.*; also in the same locality, March 18, 1907, *Coker 126 p.p.*, associated with *Caulerpa flagelliformis ligulata* and *Polysiphonia paniculata*. This small repent 4-siphoned plant is evidently allied to *Polysiphonia sertularioides* (Grat.) J. Ag. and *P. subtilissima* Mont., but is apparently not referable to either. It seems to differ from both in having the ultimate ramuli obviously narrowed at the base, from *P. subtilissima* also in the smaller tufts, and from *P. sertularioides* in the much less conspicuous hairs. It is possible that the plant represents an undescribed species but our material is scanty and sterile, and, with *Polysiphonia Gelidii* Zanard. and certain other oligosiphonous repent species known to us from brief description only, we would hardly venture at this time to propose for it a new specific name.

POLYSIPHONIA CURTA Mont. Ann. Sci. Nat. Bot. II. **20**: 301. 1843. Kütz. Tab. Phyc. **13**: *pl. 50. f. a, b.* 1863. *Polysiphonia fastigiata* Mont. Fl. Boliv. 20. 1839. Not *P. fastigiata* Grev. Fl. Edin. 308. 1824.

This was described from Cobija, once in Peru, but now within the limits of Chile. Nothing resembling it has been found in the collections made by Dr. Coker. The name "*Polysiphonia*

boliviensis Mont. Fl. Boliv. p. 20 (non Greville)" appears in the synonymy of *P. curta* as given by De-Toni (Syll. Alg. **4**: 959) but the name does not appear in the place cited and we do not find that it was ever published except thus by De-Toni.

PTEROSIPHONIA Falkenb.; Schmitz, Flora **72**: 448. 1889; Engler & Prantl, Nat. Pflanzenfam. 1^2: 443. 1897

PTEROSIPHONIA DENDROIDEA (Mont.) Falkenb. Rhodomelaceen 268. 1901

Polysiphonia dendroidea Mont. Ann. Sci. Nat. Bot. II. **8**: 353. 1837; Fl. Boliv. 16. *pl. 5. f. 1.* 1839. Kütz. Tab. Phyc. **13**: 9. *pl. 25. f. a, b.* 1863.
Polysiphonia spinifera Kütz. Phyc. Gen. 416. 1843; Tab. Phyc. **13**: 9. *pl. 24. f. a–d.* 1863.
Polysiphonia Bartlingiana Kütz. Phyc. Gen. 416. 1843; Tab. Phyc. **13**: 9. *pl. 24. f. e, f.* 1863.
Polysiphonia calliptera Kütz. Phyc. Gen. 417. 1843; Tab. Phyc. **13**: 9. *pl. 25. f. c, d.* 1863.
Polysiphonia parasitica β dendroidea (Mont.) J. Ag. Sp. Alg. **2**: 931. 1863.

In beach drift, La Punta, region of Callao, January 25, 1907, *Coker 35 p.p.*; dredged in about five fathoms, between San Lorenzo and La Punta, February 5, 1907, *Coker 58 p.p.*; pulled up with a fish-line from six fathoms, Bay of Pacasmayo, March 14, 1907, *Coker 123 p.p.*; dredged in about five fathoms, Bay of Sechura, April 8, 1907, *Coker 157 p.p.*; on surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 195 p.p.*; from drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*

All of the first four specific names cited above were originally applied to plants collected on the coast of Peru and we adopt for the present Falkenberg's opinion that they apply to forms of a single variable species. Some of Dr. Coker's specimens (58 and one of the four under 465) are near Montagne's type except in being smaller; the others are close to Kützing's *Bartlingiana* and *spinifera*. The typical form and *spinifera* occur together under no. 465 and are strikingly different in habit, but the *Bartlingiana*

forms found elsewhere appear to make it difficult to consider them distinct species. Most of the specimens are apparently sterile, but of those under 123, one is cystocarpic and some others are incipiently tetrasporic. Of those under 465, the one just alluded to as being close to the type bears cystocarps.

BOSTRYCHIA Mont. in Sagra, Hist. Cuba, Pl. Cell. 39. 1838. Falkenb. Rhodomelaceen 504. 1901.
Not *Bostrychia* Fr. Sv. Vet. Akad. Handl. **1818**: 119. 1818

? *Scorpioides* Rouss. Fl. Calvad. 88. 1806 [ed. 2].
Amphibia Stackh. Mém. Soc. Imp. Nat. Moscou **2**: 58, 89. 1809.
Scorpiura Stackh. Ner. Brit. ix, xi. 1816 [ed. 2—not seen.]
Not *Scorpiurus* L. Sp. Pl. 744. 1753.
Helicothamnion Kütz. Linnaea **17**: 105. 1843; Phyc. Gen. 433. 1843.
Stictosiphonia Harv. in Hook. f. Fl. Antarc. 483. 1847.

BOSTRYCHIA LEPRIEURII Mont. Ann. Sci. Nat. Bot. III. **14**: 287. 1850. Kütz. Tab. Phyc. **15**: 9. *pl. 23. f. a–c.* 1865

? *Bostrychia rivularis* Harv. Ner. Bor.-Am. **2**: 57. *pl. 14. f. D.* 1853. Kütz. Tab. Phyc. **15**: 9. *pl. 22. f. d–g.* 1865.

Associated with *Caloglossa Leprieurii*, on and with oyster shells on the roots of *Rhizophora*, near Capón, region of Tumbes *Coker 359 p.p.*—a few small, perhaps depauperate plants, one with two or three somewhat rostrate cystocarps, the others sterile or with very young stichidia. The plants are greenish, but may have been decolored by the preserving fluid (formalin) or by the fresh water that, according to Dr. Coker, doubtless floods the aestuaries of the Tumbes region after the winter rains.

The original materials of *Bostrychia Leprieurii* Mont. (*Leprieur 1113*) we have been able to examine through the courtesy of the officials of the Muséum d'Histoire Naturelle of Paris. Leprieur's specimens came from French Guiana "in locis aqua dulci et salsa alternatim obrutis." As compared with *B. rivularis* Harv. of the eastern and southern United States, the branches of Leprieur's specimens are commonly, though not always, more

strict and fastigiate and there are 6–10 pericentral siphons, while in *B. rivularis*, so far as we have observed, there are 6–9 pericentral siphons. We have not observed any other noteworthy differences, though we have not examined cystocarps in the original *B. Leprieurii*. The thallus of *B. Leprieurii* has the external appearance of being regularly segmented, with the ends of the pericentral siphons of each segment nearly even, as well represented by Kützing, who evidently drew his figures from authentic material, and Harvey's figures of *B. rivularis* show the same character, which is exhibited also by Dr. Coker's specimens. Kützing's figure of *B. rivularis*, however, shows more irregularly disposed and relatively shorter pericentral siphons and he accordingly endows it with "articulis obsoletis." Such specimens from the southern United States we have seen, currently referred to *B. rivularis*. The original *B. Leprieurii* shows monosiphonous apices 2–6 cells long; Harvey represents *B. rivularis* as having unbranched monosiphonous apices 8–14 cells long; Kützing reduces the monosiphonous apex of *B. rivularis* to one cell; in Dr. Coker's Peruvian material many of the branches show monosiphonous apices 4–12 cells long; these cells are not so elongate as in *B. Moritziana* (Sond.) J. Ag. and such apices are not branched. Hapteres are of occasional occurrence in the Peruvian specimens but are not such a regular and striking feature as in the original *B. radicans*, which has the appearance of being specifically distinct.

De-Toni (Syll. Alg. **4**: 1150. 1903) places *Bostrychia Leprieurii* in Falkenberg's section *Stictosiphonia*, possibly because J. Agardh once placed it in a differently characterized section *Stictosiphonia*, but the plant belongs in the section *Helicothamnion* as defined by Falkenberg and by De-Toni. It certainly should go into whatever section receives *B. rivularis* and we do not know by just what characters *B. rivularis* may be distinguished from it.

STREBLOCLADIA Schmitz, in Engler & Prantl, Nat. Pflanzenfam. 1[2]: 457. 1897

STREBLOCLADIA CAMPTOCLADA (Mont.) Falkenb. Rhodomelaceen 345. *pl. 20. f. 9, 10.* 1901

Polysiphonia camptoclada Mont. Ann. Sci. Nat. Bot. II. **8**: 352.

1837; Fl. Boliv. 19. *pl. 5. f. 2.* 1839. Kütz. Tab. Phyc. 13: 10. *pl. 27. f. c–f.* 1863.

In beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 30 p.p.* and *35 p.p.*; from rocks in the surf, Mollendo, Aug. 1908, *Coker 565 p.p.* (with immature cystocarps).

The type was collected at Callao by d'Orbigny. Piccone* reports it from Paita as well as from the region of Callao. Specimens from near Callao, collected by Marcacci, were distributed in Hauck & Richter, Phykotheka Universalis, no. 361.

The plant from San Pedro, California, distributed in Collins, Holden, & Setchell, Phycotheca Boreali-Americana (no. 1599) as *Streblocladia camptoclada* has, at least in the Columbia University copy, an obviously monopodial structure, and, we believe, does not belong in the genus *Streblocladia*.

Streblocladia spicata sp. nov.

Plants erect, elongate-virgate, wholly ecorticate, 10–20 cm. high; main axes (sympodial but superficially and illusively monopodial) simple or 2 or 3 times subdichotomous near the base or occasionally above, percurrent, 0.5–0.3 mm. in diameter in basal parts, 0.35–0.2 mm. towards the apices, subterete or flattened in a 4 : 5 ratio, showing in section 10–12 pericentral siphons and bearing numerous short suberect or ascending apparently distichous spicate or spicate-fasciculate branches (secondary sympodial axes) usually 8 or 9 segments (about 0.8–1.6 mm.) apart, these falsely lateral branches mostly 2–10 mm. long, those from near the middle of the main axis sometimes 25 mm. long and thence diminishing in length towards both apex and base, all (except the occasional abortive or once dichotomous) bearing apparently 2–4 ranks of acuminate or spiniform, often recurved and occasionally subfalcate-recurved ultimate ramuli 0.25–0.65 mm. long, these, in the more vigorous, more or less intermingled with very short sympodial axes of the third order; ultimate ramuli showing usually 6–9 pericentral siphons, the number decreasing rather abruptly at the commonly spiniform, often indurated and brownish, 1- or 2-celled monosiphonous apex; segments in the upper parts 2.5–4 times, in basal parts 3.5–5 times, as broad as long, the short pericentral siphons often showing a slight spiral twist and in the older parts often becoming somewhat irregular in size and position; reproductive parts wanting. [PLATE 56; PLATE 57, FIGURES 1–8.]

* Alg. Vettor Pisani 82. 1886.

Attached to a shell and washed ashore at Pisco, *Coker 465 p.p.*, July 7, 1908.

The present species is perhaps mostly nearly allied to *Streblocladia fasciculifera* (Kütz.) Falkenb. from the Cape of Good Hope (not *Polysiphonia fasciculifera* Kütz. Tab. Phyc. 13: *pl. 61. f. a–d*), but evidently is amply distinct in the spiciform rather than fasciculate grouping of its secondary and tertiary axes, in the shorter ultimate ramuli (¼–½ as long), which are mostly recurved at the apex (forcipate-incurved in only the very youngest parts), and in having 10–12 pericentral siphons in the main axes instead of 14–18. In habit *S. spicata* is a little suggestive of strict slender conditions of *Acanthophora spicifera* (Vahl) Börg., but is always much more slender and delicate.

"*Polysiphonia Zimmermanni* Suhr mscr.," attributed to Callao, and cited by J. Agardh* in the synonymy of *Polysiphonia thyrsigera* and by De-Toni† in the synonymy of *Bryocladia thyrsigera*, possibly belongs here, but we have no means at hand for proving it. The number of pericentral siphons of the La Guayran *Polysiphonia thyrsigera* J. Ag. is essentially the same as in *Streblocladia spicata* and Kützing's figures (Tab. Phyc. 14: *pl. 33. f. e, f.*) show branches of somewhat similar form, but both descriptions and figures indicate that *Bryocladia thyrsigera* is a plant of monopodial axes and accordingly of very different habit from that of *Streblocladia spicata*.

PLATE 56. *Streblocladia spicata*

A photograph of the type specimen (dried), natural size.

PLATE 57, FIGURES 1–8. *Streblocladia spicata*

1. A typical pinna.
2. Apical portion of main axis.
3. One of the lower pinnae.
4. Cross sections of main axes.
5. Surface view of pericentral siphons in lower part of main axis.
6. Pericentral siphons of the usual mature form in surface view.
7, 8. Apices of ultimate ramuli.

The figures are all drawn from the type material (Pisco, *Coker 465 p.p.*). Figures 1–3 are enlarged 28 diameters; 4–6, 40 diameters; 7 and 8, 245 diameters.

PLACOPHORA BINDERI J. Ag., a Rhodomelaceous epiphyte on

* Sp. Alg. 2: 955. 1863.
† Syll. Alg. 4: 967. 1903.

Codium, has been reported from Peru under the name of *Rhodopeltis Geyleri* Asken. (Bot. Morph. Studien 42. *f. 61–68.* 1872), the identity of which the originally South African *Placophora Binderi* has been vouched for by Goebel (Flora **72**: 3. 1889) and by Falkenberg (Rhodomelaceen 338. 1901). We have not been able to discover anything like it on the Peruvian specimens of *Codium* collected by Dr. Coker.

Family CERAMIACEAE

GRIFFITHSIA Ag. Syn. Alg. Scand. xxviii. 1817 [as *Griffitsia*]

Polychroma Bonnem. Jour. Phys. **94**: 191. 1822. (Not seen.)
Ascocladium Naeg. Sitzungsb. Königl. Bay. Akad. Wiss. München **1861**²: 393. 1861.
Heterosphondylium Naeg. loc. cit. 396.
Anotrichum Naeg. loc. cit. 397.

GRIFFITHSIA CHILENSIS Mont.; Kütz. Sp. Alg. 660. 1849; Tab. Phyc. **12**: 7. *pl. 21. f. d–f.* 1862

In the surf, Lobos de Tierra, April 2, 1907, *Coker 151 p.p.*

The specimen is apparently sterile, as was also the type of *Griffithsia chilensis*. The plants are shorter, more cespitose, and less straggling than the originals of Montagne and of Kützing. The filaments are mostly 250–350 μ in diameter, but are often 500 μ or more under the dichotomies; the apices are 160–250 μ in diameter. Under no. 149 p.p., same locality and date, is a mere fragment, probably of the same species, but commonly more swollen at the septa, at or near which the plant is often rhiziniferous. These rhizoids are sometimes enlarged and hapterous at apex and the filaments are thereby more or less coherent. The filaments of this no. 149 attain a diameter of 600–700 μ at the septa and occasionally 1 mm. under the di- or tri-chotomies.

Griffithsia chilensis has been attributed by Montagne (Syll. Crypt. 447. 1856) to Peru as well as to Chile. Whether it is the same as the plant from Cobija (then in Peru, now in Chile) that he had previously (Fl. Boliv. 7. 1839) referred to *G. setacea*, we do not know. Kützing, at the place of original publication of *G. chilensis*, gave it a position immediately following *G. setacea*.

PLEONOSPORIUM Naeg. Sitzungsb. Königl. Bay. Akad. Wiss. München 1861²: 339. 1861

PLEONOSPORIUM VENUSTISSIMUM (Mont.) De-Toni, Syll. Alg. 4: 1309. 1903

Callithamnion gracillimum? Mont. Fl. Boliv. 11. 1839. Not *C. gracillimum* Ag. Sp. Alg. 2: 168. 1828.

Callithamnion versicolor Mont. loc. cit. 12. Not *C. versicolor* Ag. Sp. Alg. 2: 170. 1828.

Callithamnion venustissimum Mont. Ann. Sci. Nat. IV. 14: 172. 1860. Kütz. Tab. Phyc. 12: 1. *pl. 1. f. a, b.* 1862.

On *Grateloupia Cutleriae* in beach drift, La Punta, region of Callao, Jan. 25, 1907, *Coker 35 p.p.*; on *Chaetomorpha, Cladophora,* etc., in beach drift, La Punta, Jan. 25, 1907, *Coker 38 p.p.*; on or with *Glossophora Kunthii*, in the surf, San Lorenzo Island, region of Callao, Feb. 5, 1907, *Coker 57 p.p.*

Dr. Coker's material is from the type locality. The ultimate ramification is often more irregular than represented by Kützing's figures and some of the ultimate ramuli have occasionally rhizoidal prolongations. In no. 57, the segments of the main axes are very rarely, as represented by Kützing, of the same diameter at their distal end as at their proximal end, but are, in the older parts, at least, conspicuously inflated at the base and narrowed above, so that their diameter above is sometimes only one half the diameter at their base. This diminution in diameter may be rather gradual or quite abrupt, giving to the main axis in either case the peculiar appearance of being composed of a series of superposed flasks. This basal enlargement of the segments was referred to in Montagne's first description of the plant (Fl. Boliv. 11. 1839), when he identified it doubtfully with *Callithamnion gracillimum* Ag., but was not mentioned when he finally described it as a new species, though it is a conspicuous feature of a part, at least, of his original material. In Dr. Coker's nos. 35 and 38, this character is much less pronounced, though distinctly recognizable in the older parts. In nos. 35 and 38, some of the lower segments of the main axis are loosely and imperfectly overgrown with decurrent rhizoids; in no. 57, we have not observed any approach to cortication, though the basal attachment discs are

present. No. 38 is antheridial. The antheridia are soon confluent along the ventral (upper) faces of the ramuli; they are somewhat similar in general character to those figured by Thuret (Études Phyc. *pl. 33*) for *Callithamnion corymbosum*, but are finally confluent for several consecutive segments and the lateral cells from which the antheridial cluster is evolved are larger, both relatively and absolutely, than the corresponding cells in *C. corymbosum*. No. 57 bears sporangia and polyspores; the sporangia are sessile, ellipsoid, obovoid or finally subglobose, and 55–70 μ in greatest diameter. So far as we are aware, the sporangia have not before been observed on Peruvian plants. De-Toni's reference of the species to the genus *Pleonosporium* appears to have been due to J. Agardh's hint that *P. vancouverianum* J. Ag., the sporangia of which were known, might be the same as the Peruvian plant. Setchell and Gardner (Univ. Calif. Publ. Bot. **1**: 338. 1903), as well as J. Agardh, have been impressed by the resemblance of *P. vancouverianum* to Küzting's figure of the earlier-published *Callithamnion venustissimum*. We have seen no specimens of the British Columbian and Washington plant, and are therefore in no position to hold an opinion as to the synonymy alleged by De-Toni to subsist.

CALLITHAMNION MYURUM Suhr (Flora **23**: 282. 1840; Kütz. Tab. Phyc. **11**: *pl. 88. f. d–f.* 1861) was described as coming from "Lima" (Callao?) and as occurring on "*Sphaerococcus corneus* Ag.," which is apparently the plant to which J. Agardh soon afterwards gave the name *Gelidium seminudum*. Nothing like it has been detected among Dr. Coker's specimens.

ANTITHAMNION Naeg. Neu. Algensyst. 200. 1847

Antithamnion densum (Suhr) comb. nov.

Callithamnion densum Suhr, Flora **23**: 281. 1840.
Callithamnion floccosum Mont. Fl. Boliv. 11. 1839. Not *C. floccosum* Ag. Sp. Alg. **2**: 158. 1828.

Plant small, delicate, fragile, 1–2.5 cm. long, repent in the lower parts and there more or less involved in mucus; main axis commonly denuded below, 95–140 μ broad, 3–8 times subdichotomous by the strong development of one of a pair of opposite

branches, these principal divisions distichously and oppositely pinnate and the pinnae unilaterally pinnulate; pinnae often unequal, patent or erecto-patent, nearly straight or often slightly incurved, acuminate, 0.5–0.7 mm. (7–13 cells) long, rather rigid and (like the main axes) often broken off, frequently deciduous at the small basal, potentially rhiziniferous cell, this ½–¼ as long as the next adjacent cell; pinnae bearing along their inner faces a single (rarely, now and then, two collateral) secund series of 1–6 ultimate ramuli (pinnules), the more proximal of these (in tetrasporic plant) 2–5 cells long, subacute, slightly incurved, the 1–3 more distal ramuli sometimes 5–8 cells long and equaling the continuation of the pinna; cells of main axes 160–330 μ long, mostly 1.5–3 times as long as broad, of nearly uniform diameter or sometimes a little broader at the basal end, the cell wall mostly 18–40 μ thick; median and proximal cells of pinnae 68–95 $\mu \times$ 28–48 μ, mostly 1.5–2 times as long as broad, the cell wall about 5–10 μ thick, apical cell of pinna subconical, 5–10 μ in basal diameter; tetrasporangia rather broadly ellipsoidal, about 80 μ long, finally terminal on a usually 1-celled pedicel, but commonly originating as an introrse latero-terminal outgrowth from the basal (less often the second) cell of a 2–5-celled pinnule, the distal sterile cells at length deciduous. [PLATE 30, FIGURES 8–17.]

Dredged "in 2½ fathoms," Island of San Lorenzo, region of Callao, in company with *Chaetomorpha*, *Cladophora*, etc., and more or less overgrowing them, *Coker 59 p.p.*, Feb. 5, 1907.

The original specimen of *Callithamnion densum* Suhr, which was attributed to Peru, we have been unable to locate and examine. Kützing included the species in his "Species Algarum" (650. 1849), but had not seen it. J. Agardh (Sp. Alg. 2: 66. 1851). mentioned it under "Species inquirendae." De-Toni apparently does not allude to it in his "Sylloge Algarum."

The plants from Callao that were referred to *Callithamnion floccosum* by Montagne we have seen and consider them identical with Coker's somewhat smaller specimens from the same locality. We regard them as distinct from *Antithamnion floccosum* and Suhr's description fits them so well that we feel little hesitation in adopting his specific name for them. It may be remarked, however, that, in Suhr's sentence, "Die aus jedem Absatz hervorkommenden, opposite stehenden Seitenzweige sind mit einseitigen Nebenzweigen besetzt, welche aber an den Endspitzen sich so nahe kommen, dass sie fast nicht mehr von einander zu unter-

scheiden sind," the "welche" seems intended to refer, in fact, if not in grammatical syntax, to the "Seitenzweige," and not to the "Nebenzweigen" as interpreted by Kützing and by J. Agardh. At least such an interpretation would remove the only discrepancy between Suhr's description and the Callao specimens.

Antithamnion densum is apparently to be placed with the smaller members of the "Cruciatae" section of the genus, yet seems to be amply distinct from any of the "Species nanae" of this group as described by J. Agardh and by De-Toni. It exhibits certain points of contact with *A. cruciatum* (Ag.) Naeg. (especially var. *radicans* J. Ag.), but is smaller, simpler in its branching, the branches are less crowded and scarcely "ocellate" at the apex, the pinnae are shorter, more acuminate, more rigid, and more fragile, the cells are thicker-walled, and the tetrasporangia less elongate; in *A. densum* the true pinnae are unilaterally pinnulate and the pinnules are commonly arranged along the inner or upper face of the pinna, i. e., on the side facing the main rachis; in *A. cruciatum*, the true pinna is, as a rule, distichously pinnulate in its lower part, at least, and the plane side of the pinna faces the main rhachis; in *A. densum* a careful study of the formation of the branches in the apical region shows that they are not always strictly distichous (FIG. 9), yet the variations from this arrangement are few and inconspicuous as the branches mature, while in *A. cruciatum* the successive pairs of branches are distinctly decussate and tetrastichous; in *A. densum*, the nearest approach to a 4-verticillate arrangement of pinnae is the occasional formation of an abortive vegetative branch from the rhizoidal cell at the base of the pinna, while in *A. cruciatum* a 4-verticillate arrangement is said to be not uncommon; in *A. densum*, the mature pinnae are acuminate or acute except where the apical cell has fallen off, and the conic apical cell is only 5–10 μ in greatest transverse diameter, while in *A. cruciatum* the pinnae are comparatively obtuse and the apical cell is 12–17 μ in greatest transverse diameter.

When, as shown in the figures, it happens that only one distal pinnule is elongated, the pinna has a somewhat forked appearance and when, in addition, as often occurs, the end of the pinna is slightly curved inward, the fork is rather suggestive of the chelae of certain Crustaceans.

Callithamnion Thouarsii Mont., described from Chile, is a much larger plant with distichously pinnate or even distichously bipinnate and more obtuse pinnae and there is no rhizoidal cell at the base of the pinna. We have been able to examine the original material of this species through the courtesy of Monsieur Hariot of the Muséum d'Histoire Naturelle of Paris.

PLATE 30, FIGURES 8–17. *Antithamnion densum*

8. Upper portion of one of the main branches, with apical part of the main axis broken off.
9. Apex of one of the main branches; a young sporangium at the left, below.
10. Apex of pinna of typical form.
11. A portion of one of the main branches, showing pinnules, small basal cells persisting after the fall of pinnae, etc.
12, 13. Rhizoids from persistent basal cells of pinnae that have fallen and also from the basal cell of a pinna that persists.
14. A mature sporangium, with one-celled pedicel; the same node bears also a sterile pinnule.
15. A young sporangium, latero-terminal on basal cell of a 4-celled pinnule. The three distal cells finally fall off as the sporangium matures.
16. A short fertile pinnule in which the sporangium springs from the second cell; the pinnule just above it is sterile.
17. Two fertile pinnules, each of which conceals a second fertile pinnule behind it.

All of the figures are drawn from *Coker 59 p.p.* (Island of San Lorenzo). Figure 8 is enlarged 40 diameters; 11–13, 66 diameters; 9, 10, 14, and 17, 245 diameters; 15 and 16, 390 diameters.

PLATYTHAMNION J. Ag. Anal. Alg. 22. 1892

PLATYTHAMNION ORBIGNIANUM (Mont.) J. Ag. loc. cit. 23

Callithamnion Orbignianum Mont. Fl. Boliv. 7. *pl. 7. f. 4.* 1839. Kütz. Tab. Phyc. 11: *pl. 84. f. II.* 1861.

Antithamnion Orbignianum De-Toni, Syll. Alg. 4: 1403. 1903.

Attached to *Gymnogongrus furcellatus* growing on rocks near N. E. end of water front of Callao, Dec. 27, 1906, *Coker 17 p.p.*; dredged in about five fathoms between San Lorenzo Island and La Punta, region of Callao, Feb. 5, 1907, *Coker 58 p.p.*

Montagne's original material of this handsome and well-marked species was also from the Callao region. His habit figure hardly does justice to the subdichotomous and forcipate-zigzag style of branching of the secondary and tertiary axes. His comparison of the form of the cauline cells to that of an hour-glass is a happy one, but his artist was apparently in error (*fig. 4c*) in showing a septum in the zone of constriction. The opposite

pinnae usually originate a little above the middle of the cell from which they spring. The older of the ultimate ramuli are mostly spine-tipped, but those in the younger growing parts are usually rounded-obtuse or merely acute. There is a rudimentary development of a "dorsal" and a "ventral" series of branches, and in the place of one of these rudimentary branches there is occasionally a single basal cell crested or fringed with several short branchlets, suggesting, more or less, the involucrate "conceptacle" figured by Montagne (*fig. 4d*) as occurring on a tetrasporic plant, though in our material more equidistant from the bases of the opposite branches. Our specimens are tetrasporic or apparently sterile. The tetraspores are paired, with the planes of the final divisions usually at right angles to each other.

CERAMIUM Ag. p.p. typ. Syn. Alg. Scand. xxvi. 1817. Harv. Man. Brit. Alg. 98. 1841. J. Ag. Anal. Alg. Cont. **2**: 3–48. 1894. Not *Ceramion* Adans. Fam. Pl. **2**: 13. 1763. Not *Ceramium* Wigg. Prim. Fl. Holsat. 91. 1780. Not *Ceramium* Roth, Cat. Bot. **1**: 146. 1797.

?*Apona* Adans.* Fam. Pl. **2**: 2, 519. 1763.
?*Episperma* Raf. Prec. Somiol. 48. 1814.
Boryna Grateloup; Bory, Dict. Class. Hist. Nat. **2**: 412. 1822.
Dictiderma Bonnem. Jour. Phys. **94**: 185. 1822. (Not seen.)
Hormoceras Kütz. Linnaea **15**: 730, 732. 1842.†
Gongroceras Kütz. loc. cit. 730, 735.

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* Under *Apona*, Adanson in his index (p. 519) cites "*Conferva nodosa* Dill.", which fact has been interpreted by Kuntze (Rev. Gen. Pl. **32**: 394. 1898) as the naming of a species which may serve to typify the genus. This species, with the aid of a hint from Le Jolis, he considers to be that currently known as *Ceramium diaphanum*. Dillenius, however, seems to have had no single species that is recognizable from the reference "Conferva nodosa Dill." Adanson on page 2 cites under *Apona* the nine figures on Dillenius's plate 7, of which figures Le Jolis considers the first two to represent probably Ceramiaceae, the others five species of *Batrachospermum* and two species of *Lemanea*. To these species collectively Dillenius applied the ordinal name "Confervae nodosae" and this is probably what Adanson meant by "Conferva nodosa Dill." The individual species as recognized by Dillenius bear the polynomials Conferva marina nodosa lubrica, Conferva marina nodosa, Conferva fontana nodosa, Conferva fluviatilis nodosa, etc.

† This paper was published in the last Heft of the volume for 1841. Kützing, in his Sp. Alg., appears to be consistent in citing 1842 as the date of this paper and that is probably the true date of publication.

Echinoceras Kütz. loc. cit. 731, 736.
Acanthoceras Kütz. loc. cit. 731, 739.
Chaetoceras Kütz. Bot. Zeit. **5**: 34. 1847.
Trichoceras Kütz. Sp. Alg. 680. 1849.
Celeceras Kütz. loc. cit. 683.
Pteroceras Kütz. loc. cit. 690.

CERAMIUM RUBRUM (Huds.) Ag. loc. cit. xxvii. J. Ag. Anal. Alg. Cont. **2**: 37. 1894

Conferva rubra Huds. Fl. Angl. 486. 1762. J. E. Sm. Eng. Bot. *pl. 1166.* 1803. Dillw. Brit. Conf. 78. *pl. 34.* 1803.

On *Mytilus* (?) shells, Pescadores Islands, region of Ancón, Feb. 12, 1907, *Coker 78*, "small, but common, brownish green." The specimens are tetrasporic, only 2–3 cm. high, and are probably young. The apices are strongly involute-forcipate, often suggesting in this respect Kützing's figure* of his *Ceramium involutum* from Cape Horn, but involute-forcipate apices are sometimes found in *Ceramium rubrum* as limited by modern writers. *Ceramium involutum* Kütz. was once† doubtfully cited by J. Agardh as a synonym of *Ceramium rubrum* var. *corymbiferum*, but he appears to have ignored it in his later writings and we do not find the name mentioned in De-Toni's "Sylloge Algarum." The internodes of Dr. Coker's plant are short and the corticating cells are nearly uniform throughout, suggesting J. Agardh's *Ceramium pedicellatum* (Anal. Alg. Cont. **2**: 39), but there is no sufficient evidence that J. Agardh's *C. pedicellatum* is the same as the original *C. pedicellatum* of De Candolle (Fl. Fr. **2**: 43. 1805), which Agardh omits to cite in his later references to the variety or species. De Candolle based his species chiefly upon the pedicellate character of the cystocarps (?) and describes the "articulations" as "formées par des cellules arrondies" and the "intervalles" as "formées par des cellules alongées," while Agardh is silent as to the cystocarps and says, "articulis frondis . . . differentiam strati corticalis geniculorum et articulorum parum conspicuam monstrantibus." *Ceramium rubrum* was reported from Peru by Humboldt, Bonpland, and Kunth (Nov. Gen. et Sp. Pl. 418. 1825) and from the Peruvian and Chilean coasts by Montagne (Fl. Boliv. 6. 1839).

* Tab. Phyc. **13**: *pl. 6. f. a, b.* 1863.
† Sp. Alg. **2**: 128. 1861.

CERAMIUM MINIATUM Suhr; J. Ag. Sp. Alg. 2: 135. 1851; Anal. Alg. Cont. 2: 18. 1894

On *Prionitis decipiens*, Chincha Islands, June 18, 1907, *Coker 194 p.p.*; also in the same locality, July 13, 1908, *Coker 492 p.p.*

A minute repent plant with an obviously dorsiventral and bilateral thallus. We have not been able to examine authentic specimens, but from Agardh's descriptions of *C. miniatum* we think it probable that Dr. Coker's plants are referable to this species. Agardh originally attributed it to the coast of Peru and stated that it was parasitic on other algae. Later he seems to have had doubts as to the place of origin of Suhr's original specimen, noting that Suhr wrote "Collao" (not Callao) and that the plant was adnate to a *Gelidium* which he believed to recognize as a species of the Caribbean Sea. It may be remarked, however, that Suhr had other algae from Peru (e. g. "*Solenia bulbosa*" and "*Halymenia glaphyra*") and also that *Prionitis decipiens*, the host of Dr. Coker's *Ceramium*, was originally described by Montagne as a *Gelidium*.

It is doubtful if the repent *Ceramium* from Australia (on "Melanosperms") figured by Harvey (Phyc. Austral. 4: *pl. 206A*) as *Ceramium miniatum* Suhr is really that species. At least, it seems different from the plants collected by Coker, being larger, with more involucrate, more terminal cystocarps, more globose sporangia, less obvious bilaterality in the arrangement of the corticating cells, etc. In Harvey's perhaps too schematic figures, the protoplasts of the uncorticated internodal cells are represented as cylindrical, while in Coker's plant they have that appearance only towards the base, being for the most part rhombic-ovate in optical section, becoming rhombic-lenticular towards the apices. We have seen only three or four cystocarps, which are about 110 μ in diameter and appear to lack special involucral bracts; the antheridia cover the terminal branchlets almost continuously and are found occasionally at some of the lower nodes; the sporangia are distichously biseriate, ellipsoid, ovoid, or obovoid, and are mostly 48–61 μ long and 35–50 μ wide. The main filaments are 55–68 μ broad, becoming 27–14 μ towards the apices. The lowest segments instead of being shorter than broad, as described by Agardh, are twice as long as broad, as figured by Harvey for the

Australian plant. The segments of the terminal branches are more numerous and have more nearly confluent corticated zones than is indicated by Harvey.

CENTROCERAS Kütz. Linnaea **15**: 731, 741. 1842.
J. Ag. Sp. Alg. **2**: 147. 1851; **3**: 107.
1876

CENTROCERAS CLAVULATUM (Ag.) Mont. in Durieu, Fl. Algérie **1**: 140. 1846. J. Ag. loc. cit. Mont. in Sagra, Hist. Fis. Pol. y Nat. Cuba **9**: 23. *pl. 2. f. 1.* 1845

Ceramium clavulatum Ag. in Kunth, Syn. Pl. Aeq. **1**: 2. 1822.

Centroceras cryptacanthum Kütz. loc. cit. 741. 1842; Tab. Phyc. **13**: *pl. 17. f. a–d.* 1863.

Centroceras micracanthum Kütz. loc. cit.; Tab. Phyc. **13**: *pl. 18. f. a–d.*

Centroceras leptacanthum Kütz. loc. cit.; Tab. Phyc. **13**: *pl. 18. f. e–g.*

Centroceras macracanthum Kütz. loc. cit.; Tab. Phyc. **13**: *pl. 19. f. a–c.*

Centroceras hyalacanthum Kütz. loc. cit. 742; Tab. Phyc. **13**: *pl. 19. f. d–f.*

Centroceras oxyacanthum Kütz. loc. cit.; Tab. Phyc. **13**: *pl. 20. f. a–c.*

Centroceras inerme Kütz. Sp. Alg. 688. 1849; Tab. Phyc. **13**: *pl. 17. f. e–g.*

Centroceras brachyacanthum Kütz. Tab. Phyc. **13**: 8. *pl. 20. f. d–f.*

On surf-washed rocks, Chincha Islands, July 13, 1908, *Coker 493 p.p.* The original of Agardh's *Ceramium clavulatum*, with which Dr. Coker's specimen essentially agrees, was brought from Callao by Humboldt.* Kützing's *Centroceras cryptacanthum* β *longiarticulatum* was originally described from the coast of Peru. Piccone (Alg. Vettor Pisani 53, 54. 1886) mentions Peruvian specimens of *Centroceras clavulatum* under the varietal names *brachyacanthum* and *inerme*.

* For notes on Agardh's type, see Bull. Torrey Club **38**: 509. 1911.

Family GRATELOUPIACEAE

HALYMENIA Ag. p.p. Syn. Alg. Scand. xix. 1817. J. Ag. Anal. Alg. 53. 1892

Halymenia tenera sp. nov.

Plane, gelatinous-membranous, suborbicular (?), 2–5 cm. (or more?) wide, very thin (100–150 μ), extremely delicate and fragile, commonly rugose, minutely scrobiculate, or subfenestrate, the margins subentire or sinuate-dentate, soon becoming erose or erose-lacerate; medulla gelatinous but moderately compact, its filaments rather homogeneous, 6–13 μ in diameter, or 22–28 μ including the outer soft deliquescing gelatinous layers of the cell walls, subdichotomous or laterally branched, occasionally stellate, interwoven, conglutinate and anastomosing, the cells mostly 35–90 μ long; subcortex of one or two series of irregularly ellipsoid, trigonous-pyramidal or substellate anastomosing cells about 18–30 μ in longest diameter (which is commonly parallel to surface); cortex 3–5 cells thick, composed of short filaments, nearly every cell (below the surface) bearing 2 or 3 rather patent branches, the terminal (superficial) cells (protoplasts) ellipsoid or obovoid, obtuse, mostly 1.5–2 times as long as broad, 8–11 μ in longest (usually vertical) diameter, in surface view elliptic, angular-elliptic, or ovate, 5–9 μ in maximum diameter, separated by hyaline intervals 1–6 μ broad; sporangia (protoplasts) 19–25 μ $\times$ 11–19 μ, the spores decussately or now and then quadrately paired.

"Dredged in about five fathoms," Bay of Sechura, April 8, 1907, *Coker 157 p.p.* Only fragments were obtained, so that we are unable to give a full description of the form and size of the complete plant. The thallus, in fluid-preserved material, is wrinkled, furrowed, ridged, pitted, and falsely bullate, though these characters are less obvious after the specimens have been pressed and dried. The plant is remarkable for its extreme delicacy and the ease with which it becomes torn and lacerate; it adheres very firmly to paper in drying. Superficially, the species might appear to fall in the *Hymenopsis* section of the genus with *Halymenia latifolia* Crouan, *H. ulvoidea* Zanard., and *H. actinophysa* M. A. Howe, yet the cortex is more distinctly filamentous and less monostromatic than in any of these species and the thallus is softer and more tender than in any of these. We are inclined to place the plant in the same section with the type of the genus,

Halymenia Floresia (Clem.) Ag., from which, however, it differs manifestly in the thinner, more delicate, more "ulvoid," rugose-scrobiculate, and apparently erose-lacerate rather than pinnately branched thallus, the more distinctly filamentous cortex, the more patent dichotomies (or trichotomies) of the corticating filaments, and the commonly more obtuse surface cells.

The specimens, as they come to us, are of an olive-green color, but it is probable that the natural color has been modified by the preserving fluid.

Halymenia doryophora Mont. (Fl. Boliv. 21. 1839) is discussed under *Grateloupia* (p. 169).

Halymenia lapathifolia Kütz. (Tab. Phyc. **16**: 35. *pl. 99.* 1866) is a *Sebdenia* (p. 162).

Halymenia limensis (Sond.) Kütz. (Tab. Phyc. **16**: 34. *pl. 97.* 1866) is described below under *Sebdenia*.

SEBDENIA Berthold, Mitt. Zool. Sta. Neapel **3**: 530. 1882; Cryptonem. Golf. Neapel 13, 21. 1884

Sebdenia limensis (Sond.) comb. nov.

Euhymenia limensis Sond.; Kütz. Sp. Alg. 743. 1849.
Halymenia limensis Kütz. Tab. Phyc. **16**: 34. *pl. 97.* 1866.
Sarcodia (?) *limensis* De-Toni, Syll. Alg. **4**: 416. 1900.

Thallus palmatifid-orbicular, about 12–15 cm. high, 10–17 cm. broad, from a subcuneate, more or less stipitate base, membranous, slightly gelatinous, thin, mostly 40–100 μ thick in sterile parts, becoming 150–225 μ thick towards base, here and there at margins, and at bases of proliferations, the 5–8 main lobes obovate or oblong-obovate, 4–9 cm. long, 2–5 cm. in maximum width, entire or again sparingly lobed in similar manner, or the thallus more dissected with more numerous oblong-obovate secondary or occasionally tertiary lobes mostly 1–1.75 cm. in greatest width and with margins in median and basal parts of thallus sparingly proliferous, undulate-crisped, or erose-dentate, the margins otherwise entire or subentire; medulla mostly rather compact and firm, occasionally (especially in cystocarpic parts) subvacuous, composed chiefly of filaments 4–8 μ in diameter with frequent enlargements 8–15 μ in diameter, cells of both medulla and subcortex usually with dense granular contents; cells of subcortex in 2 or 3 layers, 10–25 μ in longest diameter (parallel to surface); cortex proper firm, 1 or 2

cells thick (or becoming 3–7 cells thick in the incrassated parts); the superficial cells 7–13 μ high (including 2–4 μ of outer wall), mostly subquadrate or broader than high in section, polygonal and 7–16 μ in maximum diameter in surface view, with narrow clearly defined limiting walls; cystocarps deeply immersed, lightly protuberant on one or both faces, the spore-masses reniform or compressed-spheroid, 80–240 μ in greatest diameter, provided with a slightly developed or scarcely perceptible involucre (pericarp).

"Ad oras limenses . . . in herb. Binder."

This little-known species of the "inquirendae" class was not found in the collections made by Dr. Coker, but for the satisfactory determination of his material we have found it desirable to see the materials on which the species was based. Through the courtesy of Madame Weber-van Bosse, we have examined a fragment of authentic material in herb. Kützing and by the kindness of the officers of the Hamburgische Botanische Staatsinstitute we have seen the two specimens now representing the species in herb. Binder. One of the plants in herb. Binder is in habit very much like that figured by Kützing except that it is a little larger, with eight main lobes instead of five and with two of the main lobes bearing smaller secondary lobes. This specimen is cystocarpic and the cystocarps show that the species is not a *Sarcodia* to which genus it had been suspected to belong by J. Agardh (Sp. Alg. 3^1: 141. 1876) and by De-Toni (loc. cit.). The second plant in herb. Binder and the one that bears Sonder's inscription is much more numerously lobed or dissected, and, though somewhat larger, bears a superficial resemblance to Montagne's figure* of the Chilean *Halymenia leiphaemia*, of which species, as the inscription indicates, Sonder had at first considered his plant a variety. Sonder's inscription, by the way, indicates that the plant came from "Callao di Lima," no date or collector's name being given. This more narrowly and more numerously lobed specimen shows a tendency to marginal proliferation in median and basal portions and for a distance of about 3 cm. from the base the surface also is slightly roughened by a few minute excrescences 0.2–0.3 mm. in diameter, these doubtless representing abortive proliferations. As another expression, perhaps, of this tendency to proliferation

* Fl. Boliv. *pl. 6. f. 2.*

the margins of the median parts of the thallus show an exuberance of growth which manifests itself in small crispate irregular lobes or small irregular teeth. The structure of this more dissected specimen differs somewhat from that of the fewer-lobed plant, the structure of which is very well represented in Kützing's *fig. b*, but we believe that the differences are not important. One of the more striking differences is that many of the cells of the medulla and subcortex are nearly empty, while occasional cells are crowded with granules as in the other form, but this peculiar condition may well be due to a translocation of food materials in connection with the development of a proliferous habit.

The procarps or very young cystocarps of *Sebdenia limensis* we have not observed, but the mature and partially grown cystocarps show a well-developed sterile "podium" or multicellular foot somewhat as in certain Rhodymeniaceae, and this character together with the much firmer cortex were two of the principal characters depended upon by Berthold to distinguish *Sebdenia* from *Halymenia*. In *Halymenia Floresia*, the type of the genus *Halymenia*, the cortex bordering the ostiole of the cystocarp is invaginate, while in *Sebdenia limensis* and in the following species it is plane or slightly elevated.

Sebdenia lapathifolia (Kütz.) comb. nov.

Halymenia lapathifolia Kütz. Tab. Phyc. **16**: 35. *pl. 99*. 1866.
Halymenia elongata Kütz. Sp. Alg. 718. 1849. Not *Halymenia elongata* Ag. Sp. Alg. 209. 1822.

Thallus elongate-lanceolate (type specimen about 35 cm. long and 6 cm. in greatest width), often pertuse, the margins subentire, slightly undulate, or very sparingly short-lobed or dentate at base and apex (sometimes proliferous?), membranous, 110–205 μ thick; medulla somewhat compact or rather loose and subvacuous, composed chiefly of filaments 3–7 μ in diameter with granular protoplasts and imbedded in a hyaline mucus, terminating distally in ellipsoid enlargements 8–14 μ in diameter; cells of subcortex in 4–6 layers, the inner 10–20 μ in longest diameter (parallel to surface), the outer smaller, gradually more compact, 4–8 μ in longest diameter; cortex proper very firm and compact, 2–5 cells thick, its cells in distinct anticlinal rows or appearing somewhat irregularly pseudoparenchymatous in section; the superficial cells 4–10 μ high, 1–2 times as high as broad, the outer walls thin and

firm (1–2 μ thick), the cells polygonal and 5–8.5 μ in maximum diameter in surface view, with narrow very sharply defined limiting walls; cystocarps minute, immersed, slightly or not at all protuberant, the spore-masses subglobose, 55–85 μ in diameter, provided with a moderately well-developed involucre (pericarp).

"Lima (v. s. in herb. Binder)." Not collected by Dr. Coker.

This, like the preceding species, has been known only from the brief description and very good figures published by Kützing, and has been mentioned by succeeding writers among "species inquirendae." The species, it seems, is no longer to be found in herb. Binder, but the evident type, figured by Kützing, is in the Kützing herbarium, now owned by Madame Weber-van Bosse of Eerbeek, Holland. The thin, firm, very clearly defined limiting walls of the epidermal cells are a striking characteristic of the species. *Grateloupia Cutleriae*, of identity or affinity with which the species has been suspected, has a very different cortex.

Sebdenia heteronema sp. nov.

Plane, membranaceous, scarcely gelatinous, up to 30 cm. long, irregularly and subpalmately divided, the main segments mostly elliptic-oblong with broad, obtuse, retuse, or sometimes lobed or lacerate apices, the margins and both surfaces bearing numerous obcordate, obovate, suborbicular, or subreniform, short-stipitate or subsessile foliolar innovations 0.5–2.5 cm. in diameter, the incipient or abortive innovations rendering the surface scabrous here and there, and the commonly incrassate, often duplicate, margins now and then glandular-denticulate or glandular-crenulate from the same cause; thallus mostly 80–175 μ thick; medulla rather compact and firm, composed mostly of interwoven hyphae, 5–10 μ in diameter, these surrounding and filling in a framework consisting of comparatively few much larger, rarely segmented, straight or contorted, anastomosing filaments, commonly 12–35 μ in diameter, from substellate ganglia (these often 40–50 μ in diameter) and having homogeneous refringent, less often granular, contents, such filaments passing rather abruptly into the much shorter, narrower, and more granular cells of the subcortex; cortex firm, 25–40 μ (2–4 cells) thick, the ultimate cortical filaments short, 1 or 2 cells long; the superficial cells 4–18 μ high (including 3–6 μ of outer wall), 1–2½ times as high as broad, angular-orbicular and 4–11 μ in diameter in surface view, with limiting walls indistinctly defined; tetrasporangia 19–28 μ × 8–13 μ, the spores decussately paired. [PLATE 58.]

"Dredged in about five fathoms," Bay of Sechura, April 8, 1907, *Coker 157 p.p.*,—a single tetrasporic plant, without the base.

The external characters of this plant, combined with the peculiar large gangliiferous filaments that run through the medulla, will, we think, suffice for its recognition when it is met with again. The contents of these large filaments differ in character from those of other parts of the thallus in being more homogeneous and refringent. These filaments are easily visible through the cortex under low magnification by transmitted light, especially when dried material is soaked out in water; they form an irregularly anastomosing network, with occasionally irregularly distributed 3–6-pronged nodes or ganglia. The filaments and their connections may sometimes be traced in this way for 3 or 4 mm. They are sometimes straight and rather rigid, and sometimes sinuous, contorted, and irregularly swollen. On dissection it is seen that they sometimes run for 500 μ or more without a septum and that they are often tumid on one or both sides of a septum. It is possible that these specialized filaments are to be interpreted as representing a rudimentary vascular system. Stellately branched cells are found in the medulla or subcortex of the Mediterranean *Halymenia dichotoma* J. Ag., in the Lower Californian *H. actinophysa* M. A. Howe, and in a less pronounced fashion in *Halymenia Floresia* (Clem.) Ag., but in these they are the regular and normal cells of the parts in which they occur, while in *Sebdenia heteronema* they form specialized or heteromorphous nerves or ganglia in a ground substance of a different character. Specialized medullary filaments from stellate ganglia, somewhat similar to those of *Sebdenia heteronema*, though less highly differentiated,* occur in the type specimens of *Halymenia floridana* J. Ag., but typical *H. floridana* differs from the true Halymenias in being less gelatinous, in having a firmer cortex, and in the coarser more granular protoplasts of the cells of the medulla and subcortex.† Such specialized medullary filaments apparently do not occur either in the type species of *Halymenia* (*H. Floresia*) or the type species of *Sebdenia*

* Such filaments in *H. floridana* we once erroneously suspected of having something to do with the production of cystocarps (Bull. Torrey Club **38**: 511. 1911).

† The plants distributed as *Halymenia floridana* in the Phycotheca Boreali-Americana (no. 749), at least in the copy belonging to the New York Botanical Garden, have a very different structure and are evidently true Halymenias.

(*S. Monardiana*) and it is possible that the presence of such filaments may sometime be considered a character of sufficient importance to warrant a generic segregation. The whole matter of the affinities of the *Sebdenia* group appears to be in need of further study, especially in regard to the development of the cystocarp. Schmitz and Hauptfleisch (Engler & Prantl, Nat. Pflanzenfam. 1^2: 403. 1897) have placed the genus among the Rhodymeniaceae and have been followed in this by De-Toni (Syll. Alg. 4: 530. 1900). It is to be remembered, however, that with J. Agardh the group was always a section or subgenus of *Halymenia* and that Berthold, who studied the development of the cystocarp, included it in the Cryptonemiaceae. Pending further studies, it is our impression that the genus should be kept close to *Halymenia*.

The scabrous appearance of parts of the thallus of *Sebdenia heteronema* might naturally suggest some affinity with *Meristotheca*, but the tetraspores are decussately paired instead of zonate and the general vegetative structure is hardly congruent with that of *Meristotheca*. The plant adheres rather imperfectly to paper when dried under pressure. It is decolorate and olive-green as it comes to us, preserved with formalin. Dr. Coker's no. 157 was a synoptic one and it is not altogether certain to what his specific field notes under *a*, *b*, *c*, etc., may apply; under 157a, which probably means this, his note is "expanded *Ulva*-like thallus, dark red, almost purple."

PLATE 58. *Sebdenia heteronema*

Photograph of the type specimen (*Coker 157 p.p.*—from liquid preservative), reduced to a little less than one third of the natural dimensions.

GRATELOUPIA Ag.* Sp. Alg. 1: 221. 1822

The so-called species of this genus have been based chiefly upon the form of the thallus and the form is so notoriously variable

* The genus *Grateloupia* was found upon three species, or nominal species, of which the first two belong with the later-proposed *Chaetangium*, while the third, *Grateloupia filicina*, has come down to us as the type of the genus *Grateloupia*, under the "residue" principle. This mode of fixing a type is not sanctioned by the "American Code" of nomenclature, but, with the case apparently complicated by the existence of the earlier and more or less uncertain *Phoracis* of Rafinesque, we are unwilling to venture any disturbance of the long-established application of the generic name *Grateloupia*.

that the attempt to draw satisfactory specific lines is attended with great difficulties. In venturing to arrange the Peruvian forms of *Grateloupia* in the following manner, we do it with no particular confidence in the finality of the arrangement.

Grateloupia Cutleriae procera forma nova

Thallus linear, 85–175 cm. long, 4–16 cm. wide, 0.19–0.33 mm. thick, simple, the margins entire, crenulate-denticulate, crenulate-verrucose, or, very rarely, with an occasional short proliferation, or thallus broader (max. width about 25 cm., max. length about 1 m.), obovate or obcuneate-oblong and cleft to about the middle into 2–5 linear lobes, these sometimes again lobed at apices, the margins otherwise subentire; surface smooth. [PLATES 59 and 60.]

On the water-front of Callao, December 27, 1906, *Coker 17 p.p.*, "purplish"; also, in beach drift, La Punta, region of Callao, January 25, 1907, *Coker 37* (PLATES 59 and 60), "purplish"; specimens mostly tetrasporic.

The thallus of this striking plant is often pertuse with age. We had supposed the plant to be Kützing's *Halymenia lapathifolia*,* described and figured from the same locality, until we had the privilege of examining Kützing's original of this species and found it to be a plant of a different structure.

In the Kützing herbarium, now in the possession of Mme. A. Weber-van Bosse, *Grateloupia Cutleriae*† is represented by three specimens of the probably original material, which was from Valparaiso. The smallest of the three plants is 18–20 cm. long, 2 cm. in greatest width, and about 0.23 mm. thick, with nearly entire margins, and is tetrasporic. The second is also tetrasporic,

* For description, see *Sebdenia*, p. 162.

† GRATELOUPIA CUTLERIAE Kütz. Phyc. Gen. 398. *pl. 77. f. III.* 1843; Tab. Phyc. 17: *pl. 37.* 1867. *Iridaea Cutleriae* Mont. Voy. Bonite, Bot. Crypt. 63. 1846; Kütz. Sp. Alg. 726. 1849. In citing this name it has been customary to insert "Bind." in parenthesis, presumably because Kützing in the place of original publication cited "*Halymenia Cutleriae* Herb. Bind.," without stating who was responsible for the name that he found in Binder's herbarium. On Kützing's next occasion (Sp. Alg. 726) for referring to this herbarium name, he attributes it to "Mart. et Hering." Montagne (loc. cit.), without having seen Kützing's description, ascribes the herbarium name to "Mart. et Herg." In Kützing's herbarium, the apparently original label reads "*Halymenia Cutleriae* v. Mart. Valparaiso." Under these circumstances it would seem as if one were justified in omitting the parenthetical "Bind.," currently used in citing Kützing's name for this present species.

is about 40 cm. long, 6 cm. in maximum width, and 0.4–0.5 mm. thick, with a few small marginal proliferations; this thicker tetrasporic plant is, in all probability, the one that furnished the material for the detailed illustration of structure that accompanied Kützing's original description of the species and as such has good claims to be considered the historic or nomenclatural type of the species. The third specimen, which is antheridial and appears a little less coriaceous than the other two, is about 38 cm. long, 8 cm. in greatest width, and 0.32–0.4 mm. thick, with numerous small marginal proliferations, the longest of these being about 1 cm. long; this plant is well figured in Tab. Phyc. (**17**: *pl. 36*), except that it is made to appear proportionally too broad and some of the proliferations are drawn a trifle longer than they appear to be in the dried condition. This habit figure has probably furnished the "type" idea to subsequent writers, though many plants of widely different habit have been referred to the species. The original description, Kützing's habit figure, and the specimens now in the Kützing herbarium give as a composite type idea a plant of simple elongate thallus with short marginal proliferations, which may be few, numerous, or sometimes entirely wanting.

Iridaea violacea Kütz. (Phyc. Gen. 396. 1843; Tab. Phyc. **17**: *pl. 7. f. a, b.* 1867), from Peru, was very briefly described, and has remained with "species inquirendae," though J. Agardh and others have suspected it to be allied to *Grateloupia Cutleriae.* The species, as we have learned through the courtesy of Mme. Weber-van Bosse, is now represented in the Kützing herbarium by a tetrasporic fragment 4.5 cm. long, 3.0–7.5 mm. broad, and about 0.3 mm. thick, conforming in general habit to Kützing's figure, though smaller in every way; in structure, it appears to be identical with *Grateloupia Cutleriae*, of which the plant probably represents a small malformed condition. In the technicalities of publication, *Iridaea violacea* enjoys two pages "priority of place" over *Grateloupia Cutleriae*, but we do not venture to suggest that *Cutleriae* be replaced by *violacea*, especially as there is a chance that future collections may be able to show that both are connected specifically with the earlier-published *Halymenia* (?) *doryophora* Mont.

Grateloupia Cutleriae has been reported from the region of Callao and from Paita by Piccone (Alg. Vettor Pisani 55. 1886; Mem. R. Accad. Lincei IVa. **6**: —(29). 1889).

PLATES 59 and 60. *Grateloupia Cutleriae procera*

Photographs of dried specimens (*Coker 37*), the former reduced to a little less than two fifths, the latter to a little more than one third of the natural dimensions.

GRATELOUPIA SCHIZOPHYLLA Kütz. Tab. Phyc. **17**: 11. *pl. 36.* 1867

On surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 194b* (PLATES 61 and 62), "olive-green," and July 13, 1908, *Coker 493 p.p.* (♂).

Grateloupia schizophylla, originally described as coming from Chile, may possibly be found to intergrade with *G. Cutleriae*, but Dr. Coker's specimens have the appearance of being distinct. *G. schizophylla*, in its typical condition, has a deeply dissected or dichotomously branched thallus, while typical *G. Cutleriae* has a simple thallus. Two of Dr. Coker's specimens make an approach to the type of *G. schizophylla* as figured by Kützing, one of them being, however, dissected into more numerous linear segments; this more copiously forked plant, shown in our photograph (PLATE 61), is 1.2 m. long; just above its cuneate base are several close-set and unequal dichotomies, after which the segments (8–25 mm. wide) are simple or once or twice dichotomous, with subentire or irregularly proliferous margins and occasional small linear or linear-lanceolate proliferations from the general surface. But under the same collection number (194b) and manifestly of the same species occurs an individual of equal length (PLATE 62), in which the main thallus is undivided until the apical region is reached, and another individual that is once furcate a little below the middle. In these simpler forms, however, the tendency to a compound rather than a simple thallus manifests itself in the more numerous and longer ligules, which are often 4–14 cm. long. These simpler forms, though much larger in every way, are slightly suggestive of certain Californian plants that have sometimes been referred to *Grateloupia prolongata* J. Ag., but the Mexican type specimens of *G. prolongata* are (in the dried state) only 10–16 cm. long, with main axes 2–4 mm. broad, while the Peruvian plants are about 1 m. long with main axes mostly 10–25 mm. broad.

PLATE 61. *Grateloupia schizophylla*

Photograph of a dried specimen (*Coker 194b*) which exhibits frequent dichotomies near the base and few marginal proliferations, reduced to about two fifths of the natural dimensions.

PLATE 62. *Grateloupia schizophylla*

Photograph of a specimen (*Coker 194b*—from liquid preservative) exhibiting an essentially simple main axis and numerous marginal proliferations, reduced to about one half the natural dimensions.

Grateloupia doryophora (Mont.) comb. nov.

Halymenia (?) *doryophora* Mont. Fl. Boliv. 21. 1839.

The type specimen (FIGURE 43) of *Halymenia* (?) *doryophora* was collected at or near Callao by du Petit-Thouars and is now preserved in the Muséum d'Histoire Naturelle of Paris. It is a small tetrasporic plant about 8 cm. long and subpalmately dichot-

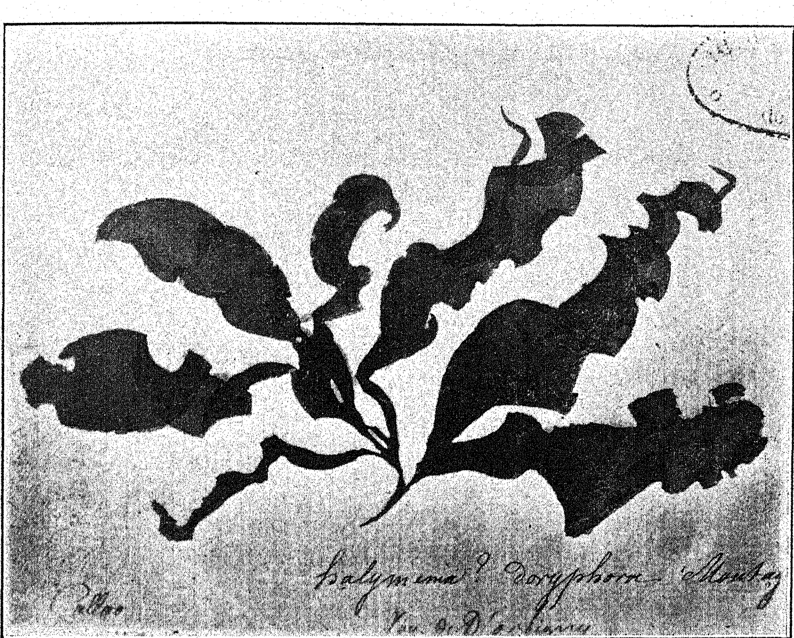


FIGURE 43. A photograph, about five sixths of the natural size, of the type of *Halymenia* (?) *doryophora* Mont., preserved in the Montagne herbarium of the Muséum d'Histoire Naturelle of Paris.

omous near the base into seven lanceolate segments which have practically entire undulate-crisped margins except that two of the

lobes have a linear-lanceolate marginal proliferation towards the apex. Most of the segments show a decided spiral twist such as is often exhibited by species of *Ulva*, etc., when they grow in eddies of water. The segments are only 0.14–0.22 mm. thick. The cortex is rather thinner than in the specimens that we have referred to *G. Cutleriae* and *G. schizophylla*, the anticlinal cortical filaments being mostly only 3 or 4 cells long, while in *G. Cutleriae* and *G. schizophylla*, they are mostly 4–6 cells long. From the Peruvian specimens that we are referring to *G. schizophylla*, *G. doryophora* differs, besides the thinner cortex, in the much smaller size of the plant and the thinner, twisted, lanceolate rather than linear segments. It is possible, however, that more extensive collections may show that the two intergrade. It is even conceivable that such widely different forms as *Grateloupia doryophora*, *Iridaea violacea*, *Grateloupia Cutleriae*, *Grateloupia schizophylla*, and *Grateloupia Cutleriae procera* may be proved to be phases of one polymorphous species, in which case *Grateloupia doryophora* would appear to be its legal name.

Nothing closely corresponding to *Grateloupia doryophora* was brought from Peru by Dr. Coker.

GRATELOUPIA SPATHULATA J. Ag. (Sp. Alg. **2**: 179. 1851), described from Peru without definite locality, we know from description and photograph only. It does not appear to occur in Dr. Coker's collections. The sheet bearing the original specimen (no. 22671 in herb. Agardh) is inscribed "Mer du Chili & du Pérou." It is therefore possible that the specimen really came from Chile.

GRATELOUPIA DENTICULATA Mont. (Voy. Bonite, Bot. Crypt. 65. *pl. 145. f. 1.* 1846) is apparently known only from the original material collected at Paita, Peru, in July 1836, by Gaudichaud. Three authentic specimens of this, one of them under an unpublished manuscript specific name, another the specimen figured by Montagne, are preserved in the Muséum d'Histoire Naturelle of Paris. The largest of these, as it lies on the paper, has an extreme length of about 16 cm. and its widely spreading branches have a span of about 25 cm. The thallus is thick (0.65–0.75 mm.) and coriaceous or cartilaginous; the cuneate

base, which is about 2 cm. long, dissolves subpalmately-dichotomously into three segments, one of which soon divides again, so that there are four main linear-lanceolate lobes, which are 8–16 mm. broad and 8–12 cm. long; two of the main segments are again subdichotomous near the apex; near the base and apex are a few lanceolate, simple or furcate marginal lobes or proliferations 1–2.5 cm. long; except at extreme base, the margins are beset with small aculeate teeth and the surfaces are scabrous with minute aculeae, verrucae, and papillae. In a section the medulla is filamentous, rather compact, and 0.3–0.5 mm. broad; the cortex proper consists of nearly parallel anticlinal filaments 6–10 cells long, these cells mostly oval-ellipsoid and twice as high as broad; the subcortex consists of several series of cells whose protoplasts are mostly 11–16 μ in maximum diameter; the peripheral or surface cells are oval or clavate, their protoplasts 3–8 μ high and 1.5–3 times as high as broad; surface jelly 4–8 μ thick. The cystocarps are minute (115–300 μ in diam.), deeply immersed, and have a small basal placenta. No form of fructification was observed by Montagne. J. Agardh (Sp. Alg. **2**: 242), knowing the plant only from Montagne's figure and description, referred it, with a question mark, to *Rissoella* and he has been followed in this by De-Toni, but the cystocarps are very different from those of *Rissoella* and its allies. It seems to us that the species is most at home in *Grateloupia*, where originally placed, though possibly a thorough examination of the development of the cystocarp might indicate other affinities. From the typical Sebdenias the species differs in the thicker thallus and the softer more distinctly filamentous cortex.

Grateloupia filiformis Kütz. was originally described (Sp. Alg. 731. 1849) as coming from Peru, but was afterwards figured (Tab. Phyc. **17**: 8. *pl. 25. f. d. e.* 1867) from a specimen attributed to St. Thomas, West Indies. It is considered by J. Agardh and by De-Toni to be a synonym of *Grateloupia filicina* (Wulf.) Ag.

PACHYMENIA J. Ag. Sp. Alg. 3^1: 143. 1876

Pachymenia cuticulosa sp. nov.

Thalli greenish (?), gregarious, from short-cuneate bases or

subsessile, membranous-coriaceous, becoming subcorneous when dry, 0.4–0.85 mm. thick, cuneate-obovoid to suborbicular in general outline, 9–20 cm. long, 4–20 cm. in maximum width, often concavo-convex or coarsely bullate-scrobiculate, sparingly and irregularly lobed, the margins subentire, or bearing here and there numerous short ligulate or spatulate, often furcate or decompound proliferations, these mostly 2–12 mm. (rarely 25–35 mm.) long, occasionally springing from the disc also; cortex 100–170 μ thick, compact and firm, consisting of anticlinal rows of 9–18 cells, these mostly 1½–2½ times as high as broad, the outer walls of the superficial cells lightly protuberant, firm, becoming with age conspicuously incrassate-lamellate, finally 10–16 μ thick (sometimes twice as thick as the vertical diameter of the protoplast); protoplasts of the superficial cells 3–5 μ in diameter when viewed from without, separated by hyaline intervals of about the same width; medulla compact, 160–580 μ thick; sporangia few, deep-seated (at the base of the cortical layer), 35–55 μ × 15–30 μ. [PLATE 63 and TEXT FIGURE 44.]

On a small pebble, in "one fathom," Isla Vieja, Bahía de la Independencia, July 20, 1907, *Coker 09642*. The plants as they come to us are a dull olive-green in color, but, as already remarked in connection with other specimens of this collection, the mode of preservation, in a formalin solution, is not well adapted for retaining the natural colors, even when light is in a large measure excluded by putting the specimens in cloth bags, as was done by Dr. Coker. However, the collector's notes give the color of the present specimen as "bright green," so it is probable that the plants give the impression of being green, even when living. The material consists of four individuals in an almost concrescent cluster. The largest of the four is tetrasporic; the others are apparently sterile.

The structure of the younger thinner ligules of Coker's 09642 is not very different from that of typical *Grateloupia* species, but the thick solid cortex of the older parts is essentially like that of the typical species of *Pachymenia*. Possibly the species should be compared with *Pachymenia apoda* J. Ag.* from Tasmania and Australia, but this is described as having at times stipitate lobes, while in *P. cuticulosa* the lobes when present are not stipitate; and *P. apoda*, it would appear, is hardly proliferous from margins and disc as is *P. cuticulosa*.

* Photographs and sketches of representatives of this species in herb. Agardh, we owe to Professor Nordstedt. The species is there represented in part by sketches of specimens belonging to the Kew herbarium and possibly to other herbaria.

Of the algae previously described from South America the only one, so far as the present writer can determine, that might be suspected of identity with Coker's 09642 is *Schizymenia Binderi* J. Ag.* from Valparaiso, but this is described as having the structure of *Schizymenia* and was kept in the genus *Schizymenia* by J. Agardh in the same volume† in which he proposed the genus *Pachymenia*. Through the courtesy of Professor A. Voigt of the Botanische Staatsinstitute of Hamburg, we have been able to examine authentic material of *Schizymenia Binderi* from the Binder herbarium and find it to be a very different plant from our *Pachymenia cuticulosa*. This authentic material of *S. Binderi* consists of two cystocarpic fragments, perhaps representing parts of a single individual. The narrower of these two fragments is 37.5 cm. long and 9 cm. in maximum width, which is near the apex; the fragment is once furcate near the base, one of the segments being represented by a short stump from which the broader of the two fragments may possibly have been detached; except for four or five short lobes or proliferations near the base and a few larger irregular lobes near apex, the margins are entire or erose-crenate. The broader of the two fragments is 34 cm. long and 14.5 cm. in maximum width, which is just below the artificially truncate apex; the thallus, as seen in sections soaked out in glycerine and water, appears to be 0.4–0.8 mm. thick. The cortexis thicker and composed of more distinctlyanticlinal filaments than in *Schizymenia Dubyi* but is only 55–80 μ thick *vs.* 100–170 μ in *Pachymenia cuticulosa;* the anticlinal cortical filaments are 5–10 cells long *vs.* 9–18 cells in *P. cuticulosa;* the outer walls of the superficial cells are only 1–3 μ thick instead of finally 10–16 μ. The cystocarps of *S. Binderi* are numerous, 80–170 μ in diameter,

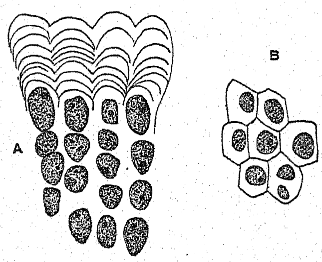


FIGURE 44. *Pachymenia cuticulosa.* A, vertical section of outer part of cortex showing thick laminated outer walls; B, the surface cells in a younger part, viewed from above; both figures are enlarged 687 diameters.

* *Iridaea Binderi* J. Ag.; Kütz. Sp. Alg. 727. 1849. *Schizymenia Binderi* J. Ag. Sp. Alg. 2: 174. 1851.

† Sp. Alg. 3[1]: 124. 1876.

and their ostioles are very conspicuous, both in surface view and in section, being irregularly elliptic and 30–100 μ in diameter at the surface and 80–160 μ deep.

PLATE 63. *Pachymenia cuticulosa*

Photograph of the type specimens (*Coker 09642*—from liquid preservative), attached to a pebble, reduced to about three fifths of the natural dimensions.

PRIONITIS J. Ag. Sp. Alg. **2**: 185. 1851

PRIONITIS DECIPIENS (Mont.) J. Ag. loc. cit. 188

Gelidium decipiens Mont. Voy. Bonite, Bot. Crypt. 76. *pl. 145. f. 2.* 1846.

Prionitis pectinata J. Ag. Sp. Alg. **2**: 189. 1851.

"In beach drift," La Punta, region of Callao, December, 1906, *Coker 23 p.p.*; "on tide rocks, Bay of Ferrol, N., region of Chimbote, common; brown, greenish near tips," Mar. 1, 1907, *Coker 118* (tetrasporic and cystocarpic); also, same locality and date, *Coker 119 p.p.*; "dark green, common," Lobos de Afuera, Mar. 27, 1907, *Coker 144 p.p.* (PLATE 65); "on surf-washed rocks, common, reddish brown," Chincha Islands, June 18, 1907, *Coker 191* (tetrasporic and antheridial); also, "dark reddish brown," same locality and date, *Coker 193c;* also, "knotty, olive-brown, common," same locality and date, *Coker 194c* (cystocarpic); Chincha Islands, July 13, 1908, *Coker 492 p.p.* (PLATE 64); "from drift on the beach," Pisco, July 7, 1908, *Coker 465 p.p.*

The specimens cited show much variation in size and habit and more especially in the number and size of the pinnae, yet we doubt if they offer any satisfactory grounds for specific segregations. Four of Dr. Coker's numbers are from the Chincha Islands, the type locality of J. Agardh's *P. pectinata*,* and among these the younger less developed individuals seem indistinguishable from *P. decipiens*, the type of which we have examined through the courtesy of Messrs. Mangin and Hariot of the Muséum d'Histoire Naturelle of Paris. The original of Montagne's *Gelidium decipiens* came from Paita, which is somewhat more than 1000 kilometers north of the Chincha Islands.

Most of the specimens collected by Dr. Coker show numerous

* A photograph of the type of this species we owe to the courtesy of Professor Nordstedt. The type is closely matched by several of Dr. Coker's specimens.

wartlike excrescences belonging to a parasitic red alga (*Lobocolax deformans*) and no. 144, in particular, has the appearance of being deformed by this endo-epiphyte. This *Lobocolax* is doubtless what Montagne refers to in "verrucisque crassis sparsis (an statu morboso productis?)." Some of the plants show in addition to the *Lobocolax* small verrucae or papillae, especially near the base, which appear to be excrescences of the plant itself, due, perhaps, in part, to irritation caused by the presence of less conspicuous endophytes and epiphytes.

The tetrasporangia in *Prionitis* have been supposed to be confined to special lateral branchlets, but in this Peruvian species they occur as frequently on the main segments or axes of the thallus, though sometimes on both the main axes and the lateral branchlets. However, they occur in nemathecia of more or less definite form, which is probably sufficient ground for allowing the species to remain in *Prionitis*, with most of the species of which it agrees essentially in consistency of thallus and general habit, even though lateral pinnae are sometimes nearly or altogether wanting. In the *Prionitis Lyallii* (*P. Andersoniana*) of the Pacific Coast of North America, the tetrasporangia may occur on small more or less specialized fertile pinnae or on broad chiefly vegetative pinnae.

Antheridia and cystocarps, like the tetrasporangia, are found on the main axes of *P. decipiens* as well as upon the lateral branchlets. The antheridia, so far as observed, are found more abundantly on the main axes, but the cystocarps show a tendency to restriction to the branchlets. The antheridial sori are extensive and cover in places nearly the whole surface of the thallus, the margins often excepted. The cystocarps are 125–230 μ in diameter and appear to be of the usual Grateloupioid character.

The two specimens that we have selected for illustration represent, perhaps unfortunately, rather extreme forms of the species. PLATE 64 shows (492 p.p.) an unusually luxuriant development of the plant, which here attains a maximum height of 70 cm., with pinnae sometimes 2–9 cm. long and 1.5–3 mm. wide; yet the left half of this same photograph shows from the same tuft less developed plants that make a close approach to the historic type of the species. PLATE 65 shows (in more nearly its natural size) a shorter stouter plant (144 p.p.) with pinnae very irregularly

and imperfectly developed; this plant is only about 19 cm. high; its main segments are less flattened and are rather more rigid and corneous on drying; the plant is copiously infested with *Lobocolax* and this fact may account for some of its peculiarities of form.

No. 465 p.p. is a form with narrow segments (1–2 mm. wide) and has almost the aspect of a distinct species. In its narrowness it is slightly suggestive of Harvey's var. *angusta* of *Prionitis lanceolata*, which has been raised to specific rank by Setchell,* though the Peruvian plant is less elongated and is otherwise different in habit.

Setchell and Gardner† have referred a Californian plant (Phyc. Bor.-Am. *199b*) to *Prionitis decipiens*, though it manifestly differs considerably from the true Peruvian *P. decipiens* in color and habit and also, apparently, in having the tetrasporangia confined to lateral branchlets.

PLATE 64. *Prionitis decipiens*

Photograph of a luxuriant long-pinnate specimen (*Coker 492 p.p.*—from liquid preservative), reduced to about two fifths of its natural dimensions. The wart-like excrescences are the external thalli of a parasitical alga, *Lobocolax deformans*.

PLATE 65. *Prionitis decipiens*

Photograph of a shorter, stouter, more frequently forked and less pinnate specimen (*Coker 144 p.p.*—from liquid preservative), reduced to about three fourths of its natural dimensions. The parasite, *Lobocolax*, is abundant and has the appearance of deforming its host.

Family DUMONTIACEAE

LEPTOCLADIA J. Ag. Anal. Alg. 95. 1892. Setchell, Univ. California Publ. Bot. 4: 250. 1912

Andersoniella Schmitz, in Engler & Prantl, Nat. Pflanzenfam. 1^2: 520. 1897.

Leptocladia peruviana sp. nov.

Plants attaining a length of 25 cm., repeatedly subdichotomous and irregularly lacerate-pinnate, the main segments distinctly costate, linear, and 1–2 mm. broad below, becoming broadly linear, 3–8 mm. wide, and obscurely costate above, the margins irregularly dentate, commonly bearing numerous flabelliform, ligulate, cuneate or often stipitate, irregularly serrate, lobed, or lacerate appendages or innovations, these mostly 2–10 mm. long

* Phyc. Bor.-Am. no. XXIV. Jl 1899. The name, however, is preoccupied by the different *Prionitis angusta* (Harv.) Okam. (Bot. Mag. 13: 4. 20 Ja 1899.)

† Univ. California Publ. Bot. 1: 350. 1903.

and 1–3 mm. wide; teeth extremely variable in form, mostly broadly triangular or triangular-lanceolate from a broad base, obtuse or more commonly acute and showing distinctly the apical cell, the central axis, and an oblique-seriate arrangement of the younger cortical cells; thickness of costa in basal and median parts 85–130 μ, in upper parts 30–65 μ, the wing mostly 20–50 μ thick; peripheral cells mostly 3–6 μ in diameter in surface view; antheridia in irregular, often marginal, bands and patches; nemathecia small, suborbicular-pulvinate, becoming widely confluent and continuous at thallus margins; sporangia 25–42 μ $\times$ 10–16 μ, the spores irregularly and obliquely paired or sometimes partially or irregularly zonate. [PLATE 66; PLATE 57, FIGURES 9–16.]

Bay of Sechura, "dredged in five fathoms," *Coker 157 p.p.*

The resemblance of this plant to the Californian *Leptocladia Binghamiae* J. Ag. (better known as *Andersoniella Farlowii* Schmitz) in both form and structure is so striking that we can feel no serious doubts as to its relationships. Yet we are of the opinion that it should not be specifically identified with the Californian plant. Its segments are commonly 3–8 mm. wide, while those of *Leptocladia Binghamiae* rarely exceed 2 mm.; marginal foliolar appendages and innovations are a conspicuous feature, while in *L. Binghamiae* they appear to be of rare occurrence; the marginal teeth are commonly more acute and show the apical cell more distinctly and the younger cortical cells have a more regular arrangement than in the Californian plant.

The Peruvian plant bears a considerable variety of endophytes and epiphytes, the more conspicuous endophytes being *Hyella infestans*, *Chlorogloea endophytica*, and *Erythrocladia endophloea*, all of which are described as new in the present paper.

The transfer of *Leptocladia* from the Rhodymeniaceae, where it was doubtfully placed by J. Agardh, to the Dumontiaceae and the recognition of the later *Andersoniella* Schmitz as a synonym, have been made by Professor W. A. Setchell in various herbaria and have recently been formally published by him (loc. cit.). The genus *Leptocladia* is given a place in De-Toni's "Sylloge Algarum" (4: 609. 1900), but appears to have been overlooked by Schmitz and Hauptfleisch in Engler & Prantl, "Die natürlichen Pflanzenfamilien," and by Svedelius in the recent Nachträge to that work.

PLATE 57, FIGURES 9–16. *Leptocladia peruviana*

9. A portion of two adjacent lobes of the thallus, showing marginal appendages and innovations.
10, 11. Apices of marginal teeth, showing apical and surface cells.
12. Outline of cross section of a thallus segment, showing position and elevation of the nemathecia.
13. Tetraspores, illustrating various types of arrangement in the sporangium.
14. Outlines of cross sections through thallus segments.
15. A similar section near base, showing a pronounced costa.
16. A portion of a cross section of the thallus, showing medullary hyphae, the central axis, two opposite branches from it, etc.

All of the figures are drawn from the type material (Bay of Sechura, *Coker 175 p.p.*). Figures 9, 14, and 15 are enlarged 9 diameters; 12, 16 diameters; 16, 245 diameters; 10 and 11, 345 diameters; 13, 390 diameters.

PLATE 66. *Leptocladia peruviana*

Photograph of the type specimen (*Coker 157 p.p.*—dried), natural size.

Family CORALLINACEAE

CORALLINA L. p.p. Syst. Nat. 1: 805. 1759. [ed. 10]

CORALLINA OFFICINALIS L. loc. cit. Kütz. Tab. Phyc. **8**: 32, 33. *pl. 66–68.* 1858. Yendo, Jour. Coll. Sci. Tōkyō **16**:—(28) *pl. 7. f. 10–13.* 1902; Setch. & Gard. Univ. California Publ. Bot. **1**: 364–367. 1903

Corallina chilensis Decaisne; Harv. Ner. Austral. 103. 1849.
Corallina officinalis chilensis Kütz. Tab. Phyc. **8**: 32. *pl. 66. f. I.* 1858. Yendo, Minn. Bot. Stud. **2**: 718. *pl. 54. f. 1.* 1902.
Corallina vancouveriensis Yendo, loc. cit. 719. *pl. 54. f. 3; pl. 55. f. 1, 2; pl. 56. f. 16, 17.* 1902.
Corallina aculeata Yendo, loc. cit. 720. *pl. 55. f. 3; pl. 56. f. 18, 19.*

From drift on the beach, Pisco, July 7, 1908, *Coker 465 p.p.*; also collected at Pisco by Dr. H. H. Rusby in March, 1885 (no. 282, in herb. Columbia University as *C. chilensis*).

The name *Corallina chilensis* Decaisne seems to have been originally intended for certain specimens collected by Gay at San Carlos de Chiloe in January, 1836, and now preserved in the herbarium of the Muséum d'Histoire Naturelle at Paris. Harvey, however, appears to have been the first to publish a diagnosis of the species, in doing which he cites "Dne. in Herb. Paris. ined." but takes occasion to remark that specimens from Valparaiso

(*Darwin no. 2151*) may "serve for the type of the species." Under these circumstances Darwin's plant rather than Gay's must probably be considered the technical type of *C. chilensis.* We have seen Gay's specimens but not Darwin's. Gay's are densely cespitose, 1.5–2.5 cm. high, rather irregularly 1–2-pinnate; the segments are 0.25–0.83 mm. broad, are mostly subterete or truncate-obconic, or somewhat flattened and occasionally twice as broad at the distal end as at the proximal; the specimens are sterile or with very young conceptacles. The plants are smaller and less regularly pinnate than that figured by Kützing as *Corallina officinalis chilensis.*

Corallina officinalis collabens var. nov.

Cespitose, 1–4 mm. high, densely 2–3-pinnate, lightly calcified; main axes 0.6–1.0 mm. broad; segments near base subterete, often more or less rugose on drying, the median and upper segments mostly flattened, vertebriform or short-truncate-obconic, rarely twice as broad distally as proximally, on drying mostly collabent, sulcate, canaliculate, or marginate on one or both faces; terminal segments cuneate-spatulate, flabelliform, fusiform, digitiform, or occasionally filiform, commonly lobed or palmatifid, sometimes bipalmatifid.

On surf-washed rocks, Chincha Islands, June 18, 1907, *Coker 194 p.p.;* in same locality and habitat, July 13, 1908, *Coker 492 p.p.*

This variety is remarkable for its often flabelliform deeply palmatifid or even bipalmatifid terminal segments and its slight calcification, which gives most of the segments a collapsed, marginate, sulcate, or rugose appearance on drying. It is doubtless allied to *C. officinalis spathulifera* (Kütz.) Ardiss., but cannot well be identified with that variety. Possibly it is nearer to *Corallina palmata* Kütz., but it is probably not *Corallina palmata* Ell. & Soland.

Amphiroa setacea Kütz. (Sp. Alg. 700. 1849; Tab. Phyc. **8**: 19. *pl. 40. f. a–d.* 1858) was described as coming from Peru. It is cited by De-Toni in the synonymy of *Amphiroa fragilissima.* We find no *Amphiroa* among Dr. Coker's specimens.

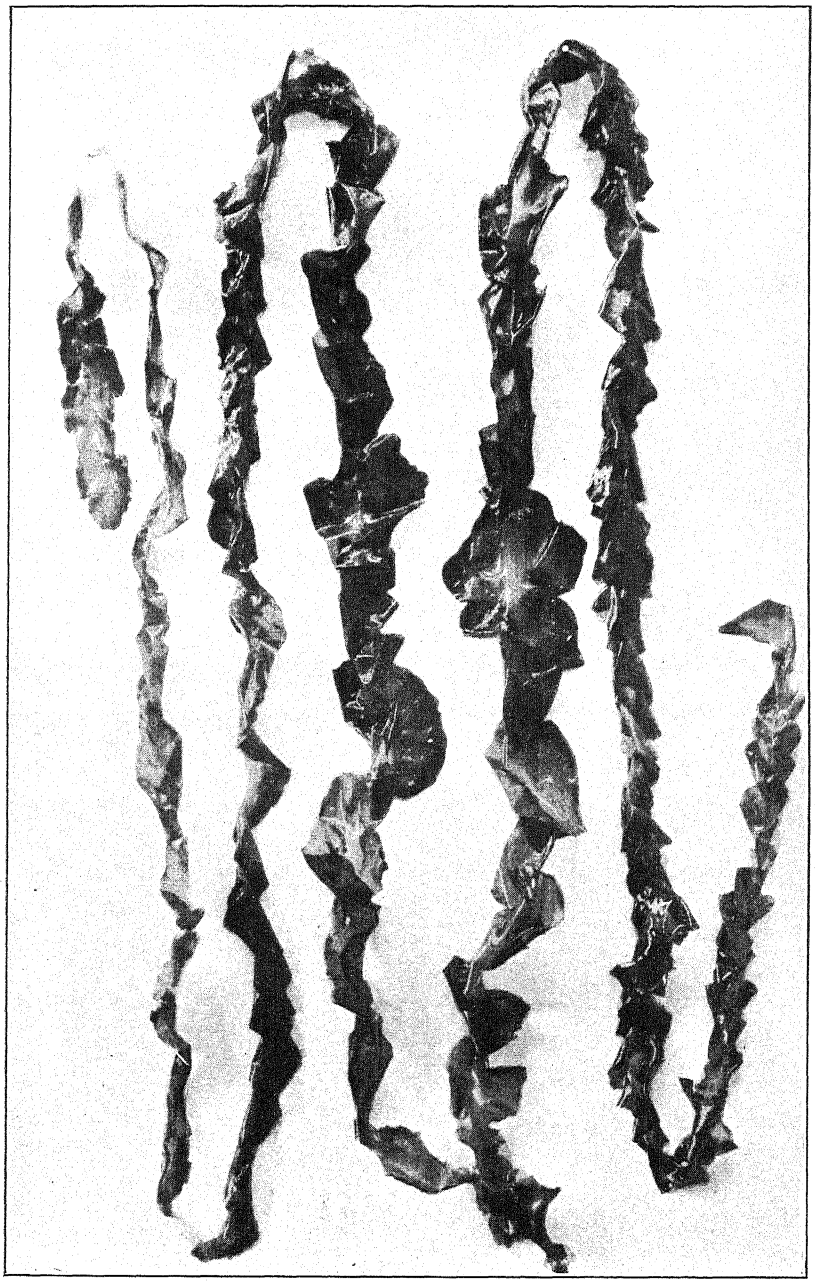
Amphiroa pacifica Kütz. (Tab. Phyc. **8**: 20. *pl. 43. f. a, b.* 1858) also was described from Peru and apparently nothing has been added to the knowledge of it since its publication by Kützing.

Amphiroa peruana Aresch. ("Phyc. Extraeur. 41. 1854") we have not seen. The species is apparently not mentioned in De-Toni's "Sylloge Algarum." It has been recorded by Farlow (Proc. Am. Acad. **38**: 93. 1902) as occurring in the Galapagos Islands and the name appears also on a printed label of the "Algae Floridanae" distributed by A. H. Curtiss and presumably determined by J. Agardh.

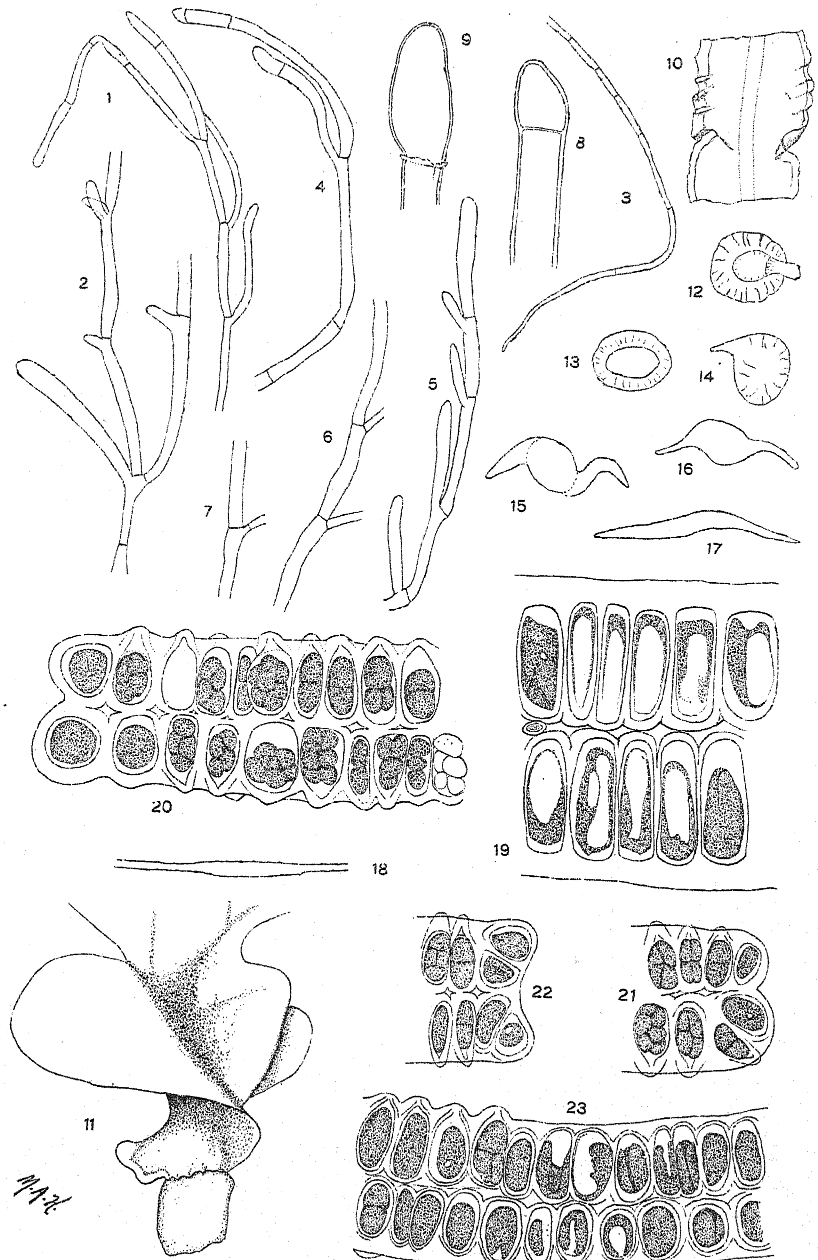
Lithothamnion ? peruviense Heyd. (Bot. Jahrb. **28**: 545. *pl. 11. f. 5.* 1901) was based on a specimen from "Coquimbo, Peru (Gaudichaud)," this being presumably the Coquimbo that has long been a part of Chile. No representative of the unarticulated corallines has been observed in Dr. Coker's collections.

INDEX

New names, the final members of new combinations, and the numbers of the pages on which the principal descriptions or notes are to be found are in **bold face type.**



ULVA FASCIATA COSTATA M. A. Howe



1-9. CLADOPHOROPSIS PERUVIANA M. A. Howe
10-23. ULVA FASCIATA COSTATA M. A. Howe

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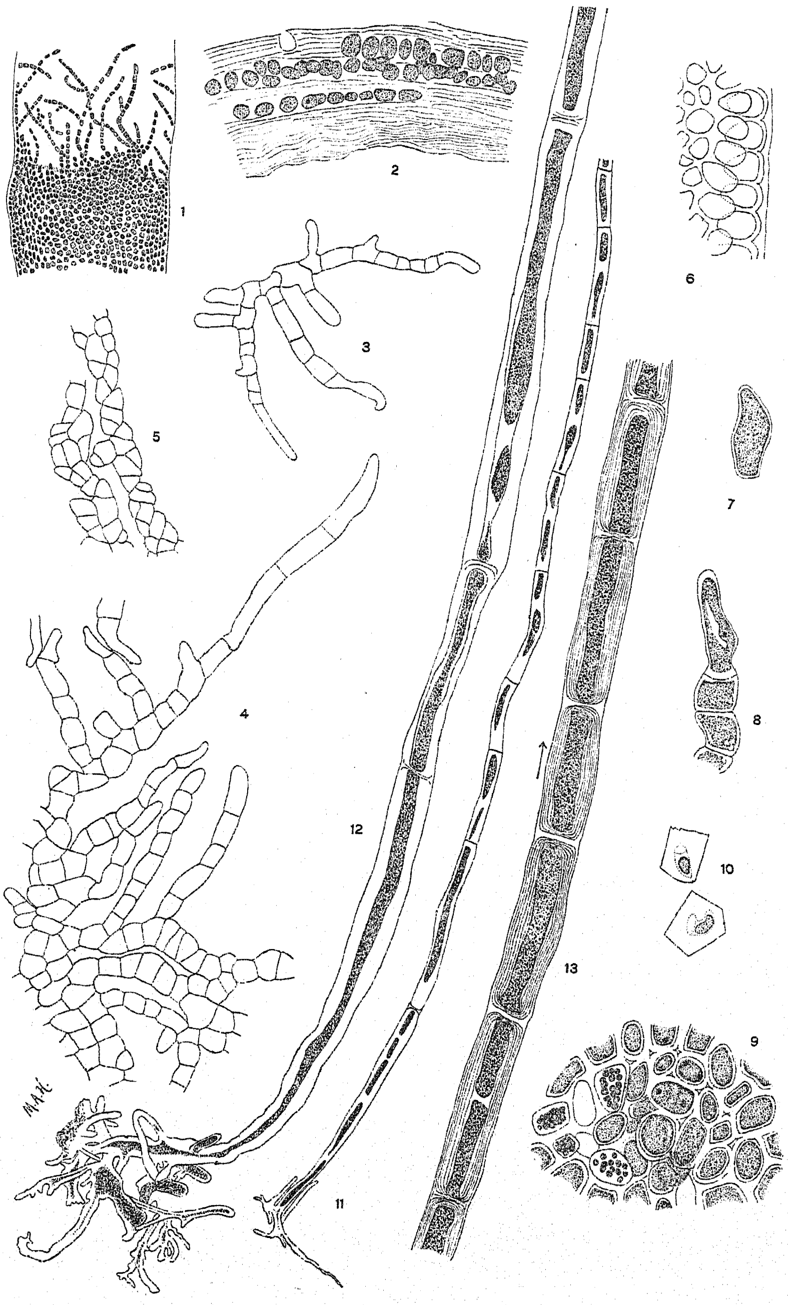

1-10. ENDODERMA STRANGULANS M. A. Howe

11-13. CHAETOMORPHA CARTILAGINEA M. A. Howe

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Cladophora Hariotiana M. A. Howe

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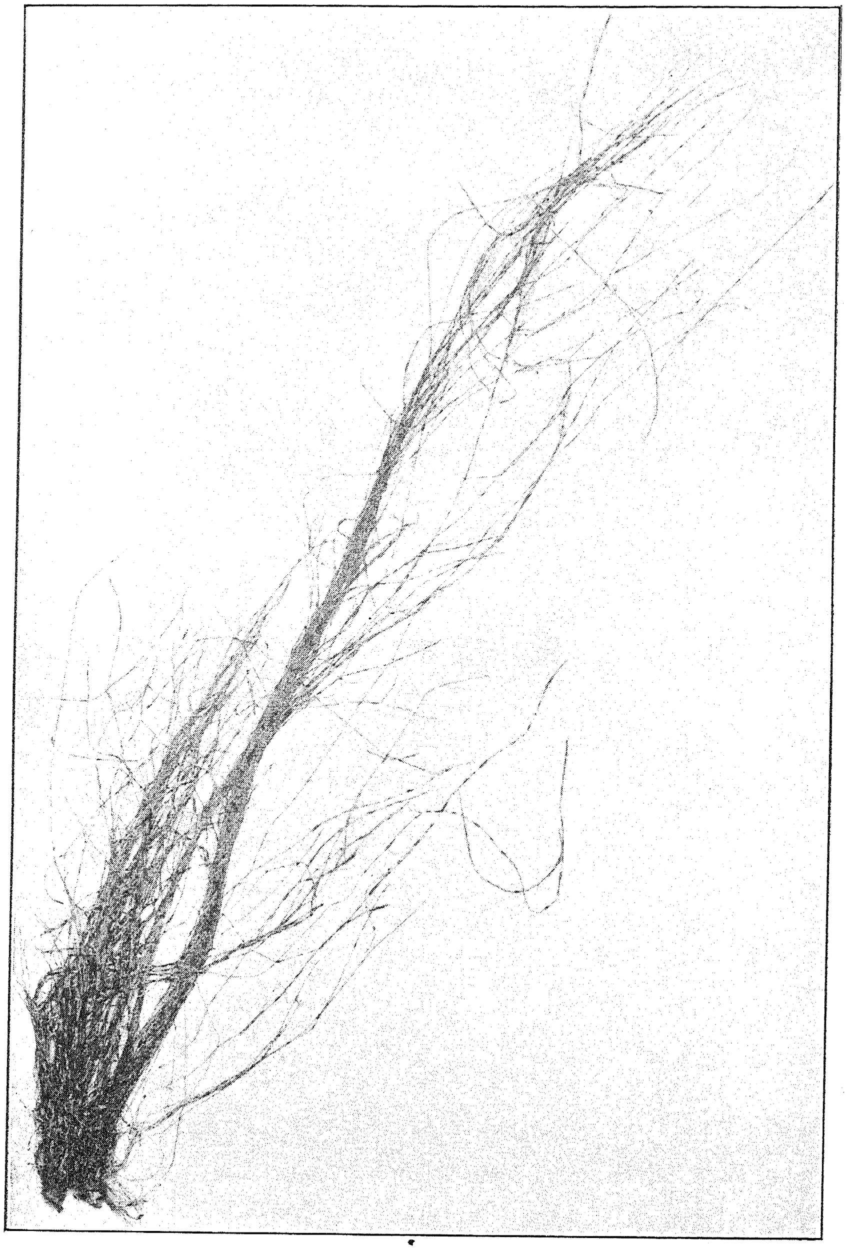

CHAETOMORPHA CARTILAGINEA M. A. Howe

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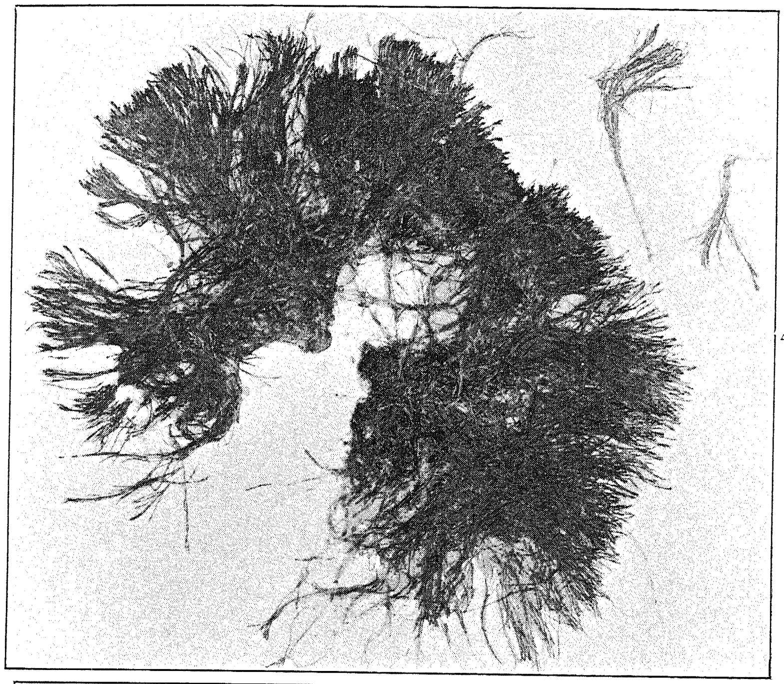

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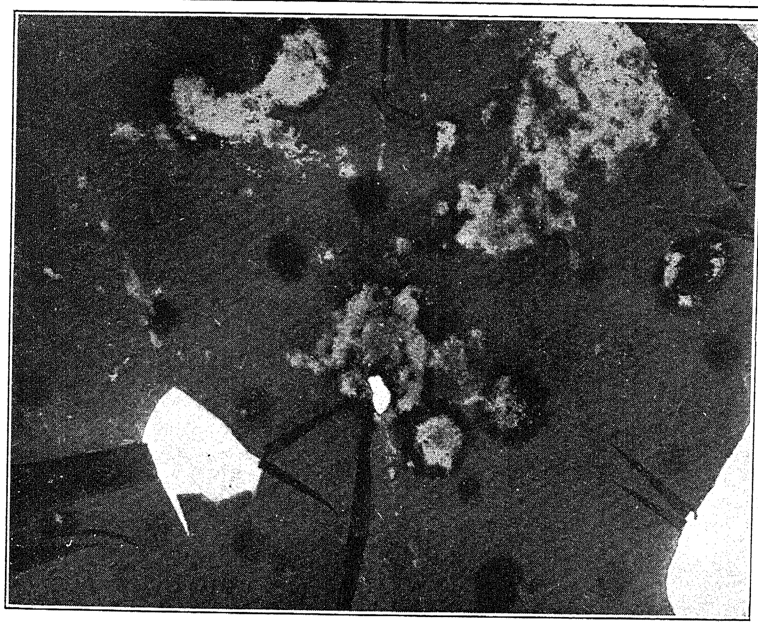

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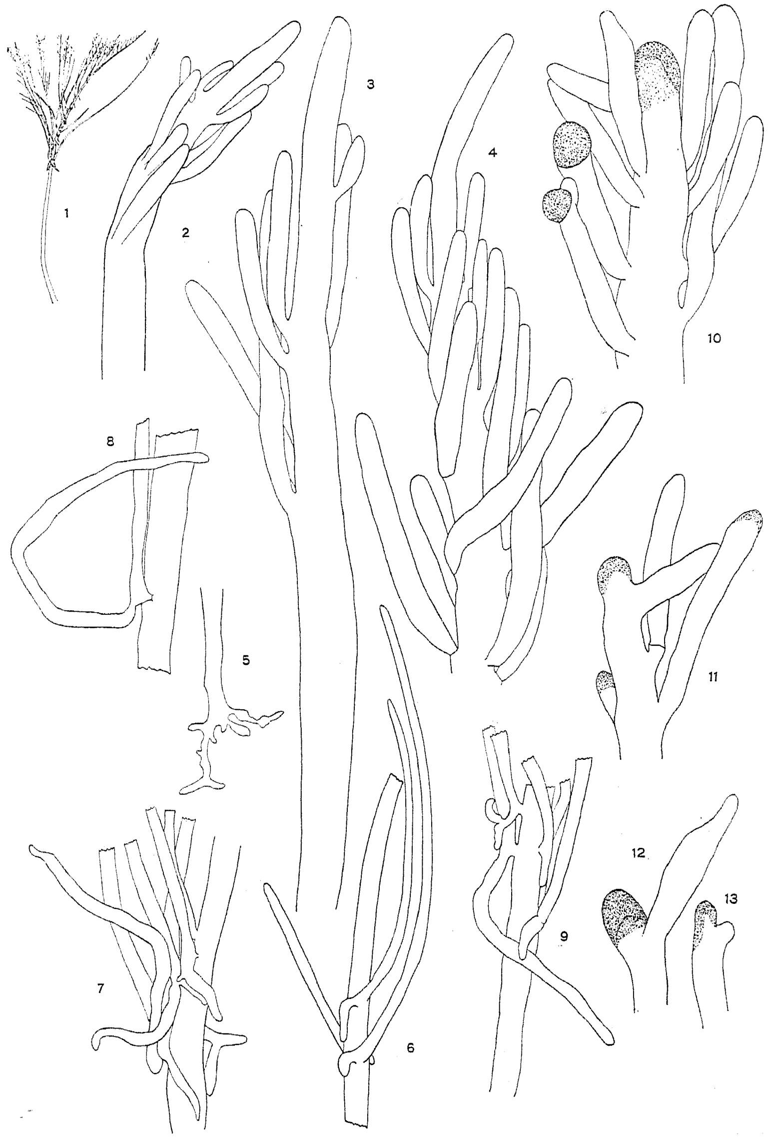
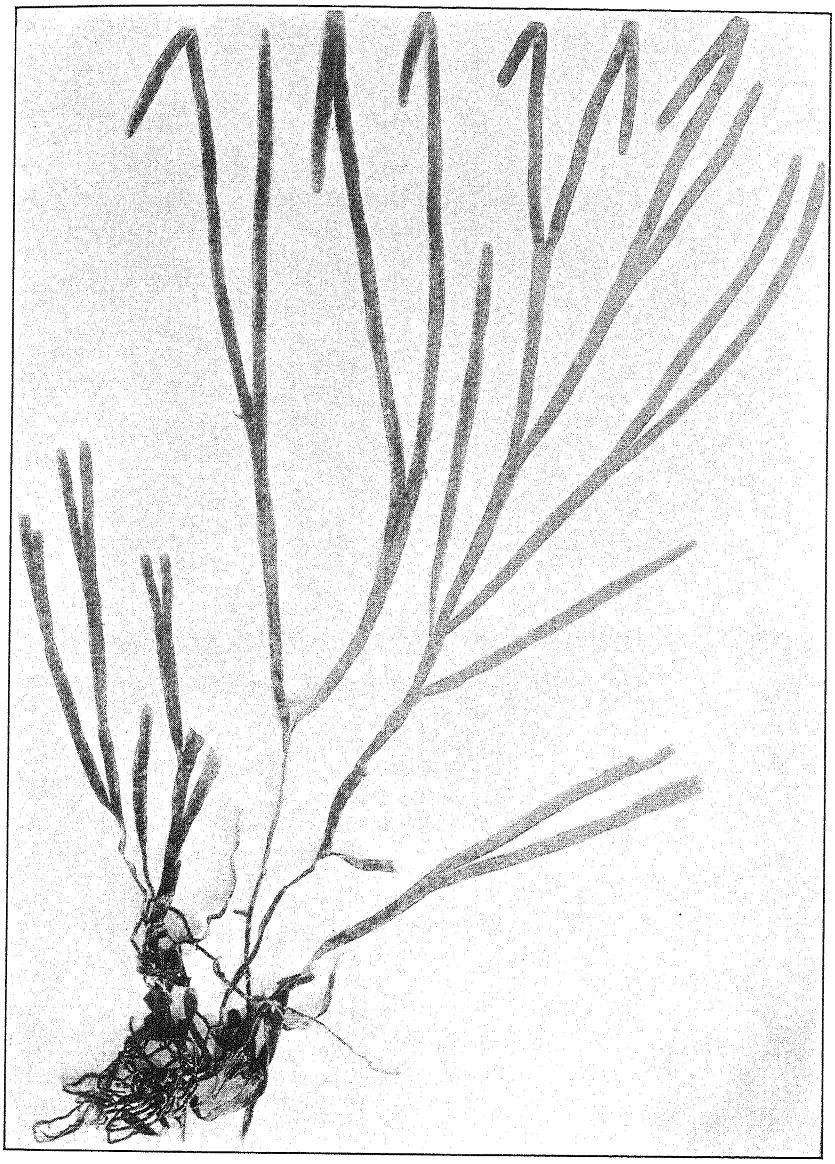
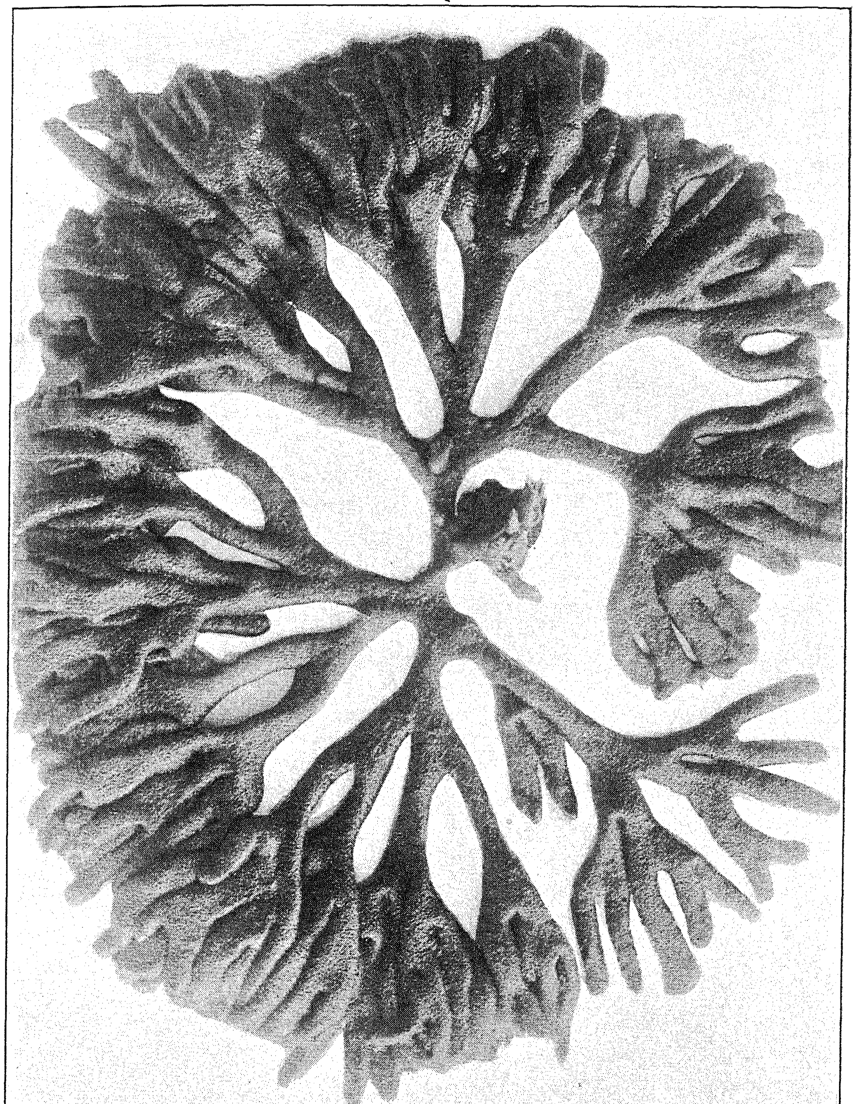
A. BRYOPSIS RHIZOPHORA M. A. Howe
B. STREBLONEMA RADIANS M. A. Howe



BRYOPSIS RHIZOPHORA M. A. Howe



CAULERPA FLAGELLIFORMIS LIGULATA (Harv.) Web. v. Bosse



CODIUM TOMENTOSUM PERUVIANUM M. A. Howe

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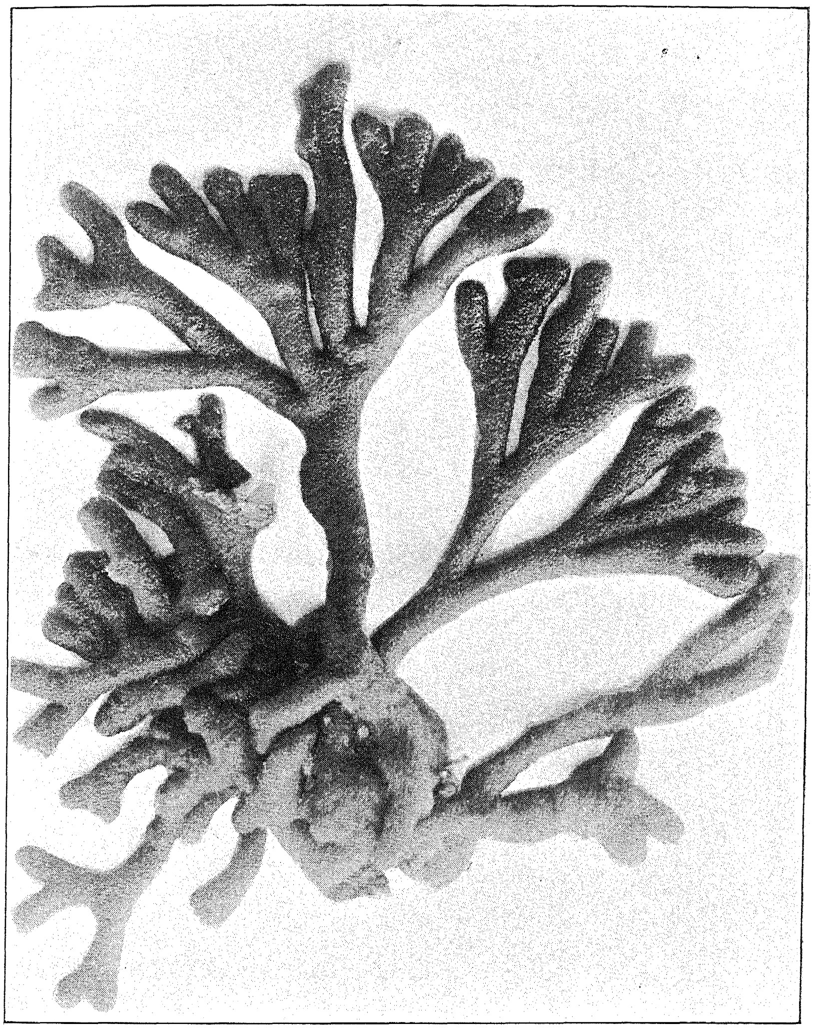

CODIUM FOVEOLATUM M. A. Howe

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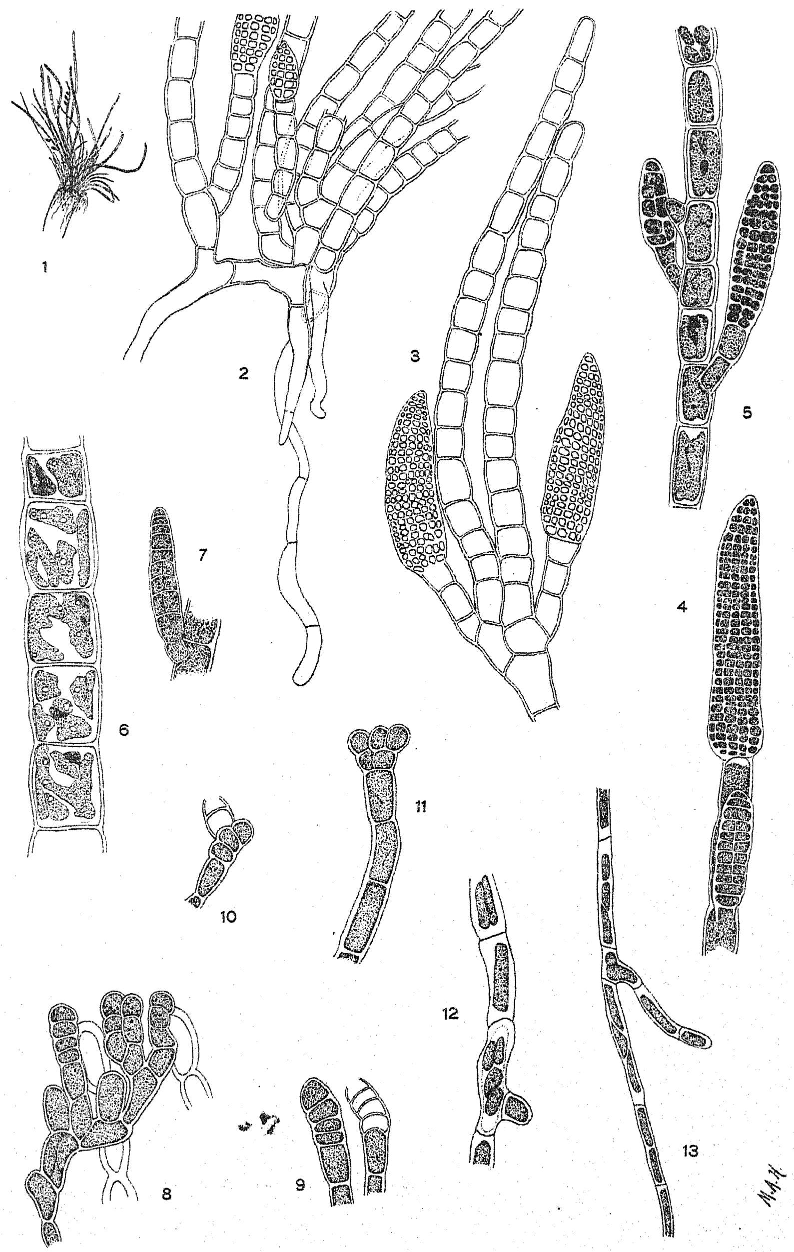
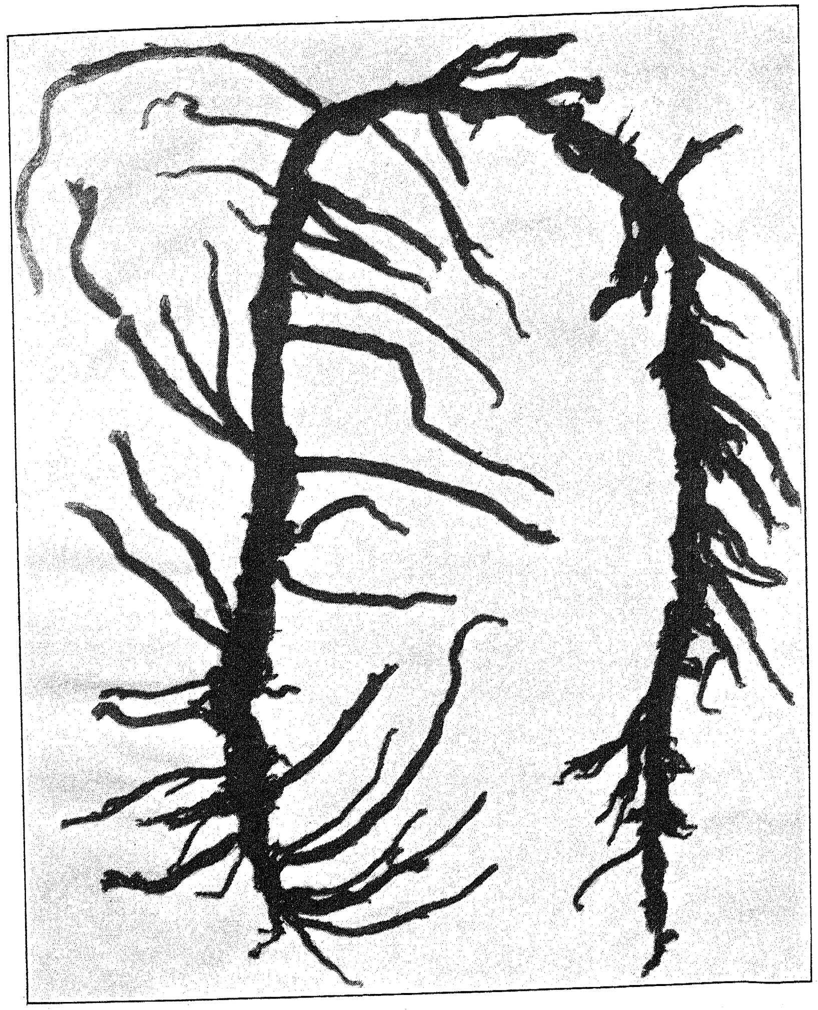


1-7. STREBLONEMA COKERI M. A. Howe

8-13. STREBLONEMA RADIANS M. A. Howe

HELIOTYPE CO., BOSTON



MYRIOCLADIA GRANDIS M. A. Howe

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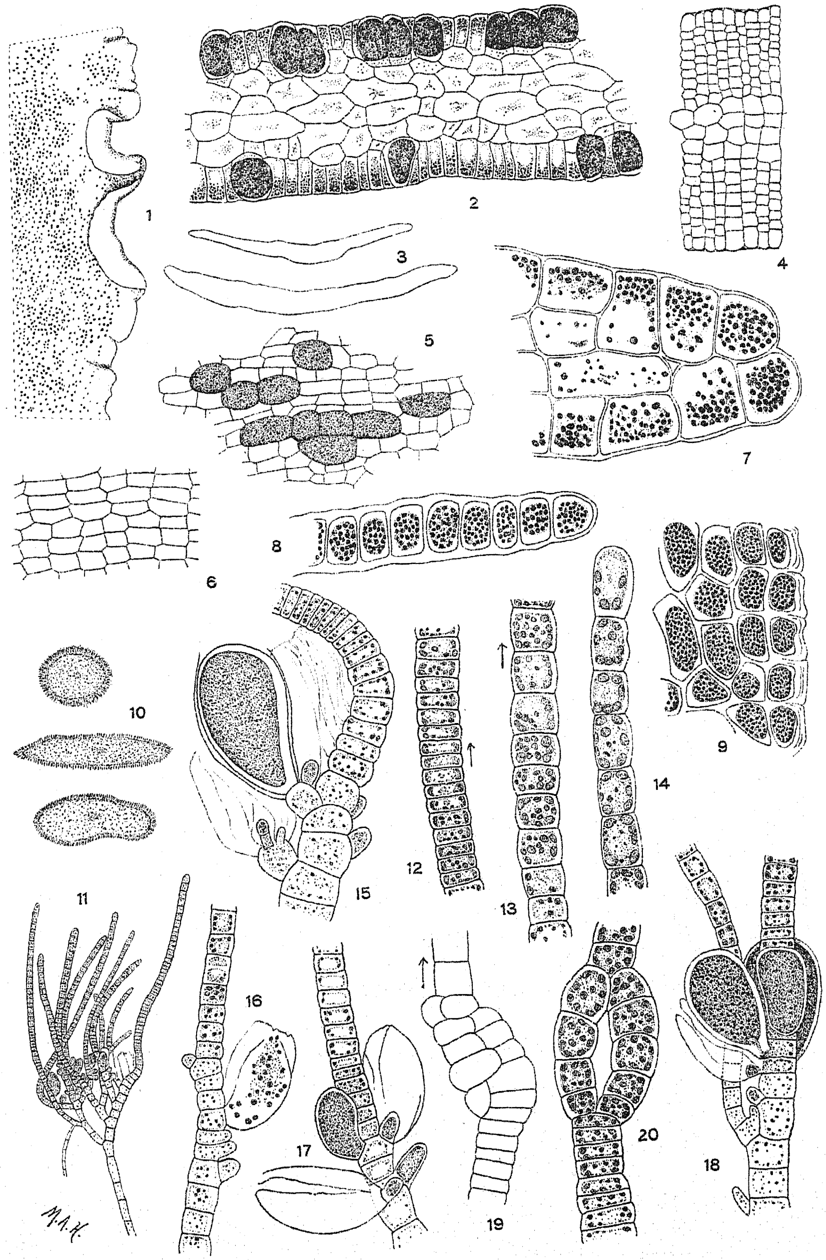

1-4. Spatoglossum crispatum M. A. Howe

5-9. Neurocarpus Cokeri M. A. Howe

10-20. Myriocladia grandis M. A. Howe

HELIOTYPE CO., BOSTON

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EISENIA COKERI M. A. Howe

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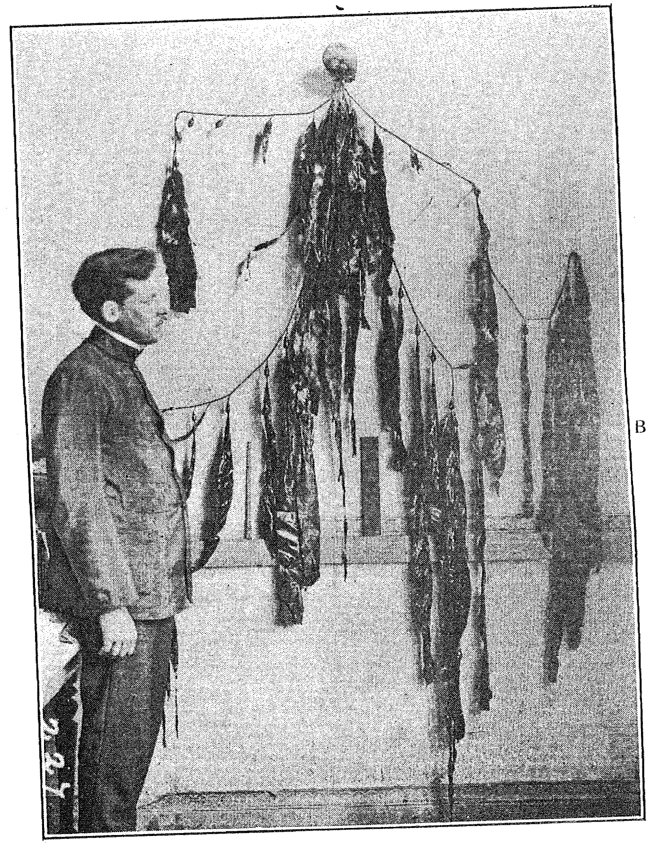

MACROCYSTIS PYRIFERA HUMBOLDTII (Bonpl.) Hook. f. & Harv.

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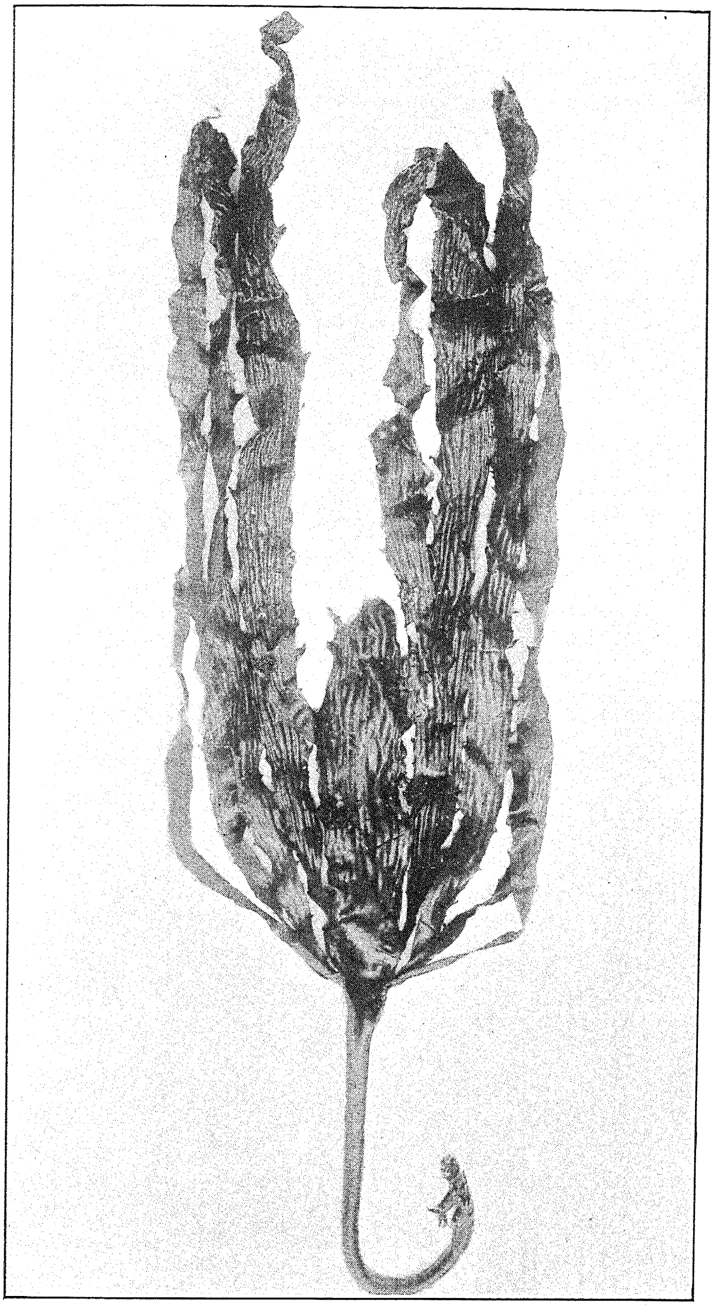

EISENIA COKERI M. A. Howe

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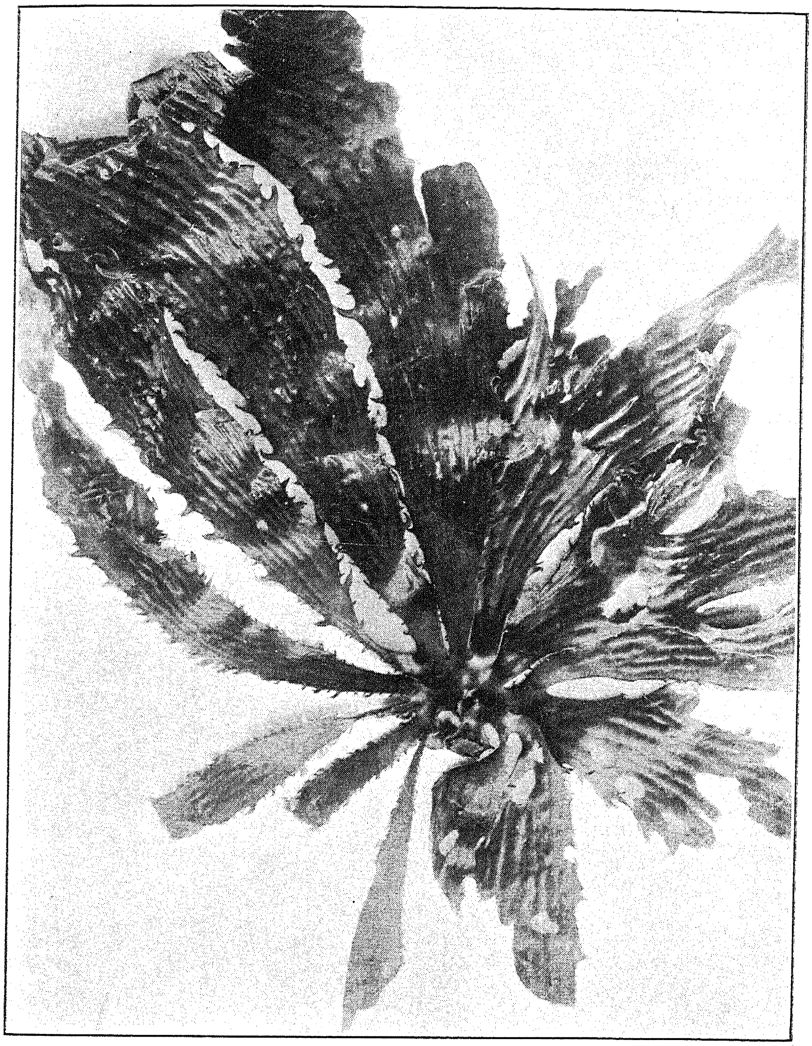

EISENIA COKERI M. A. Howe

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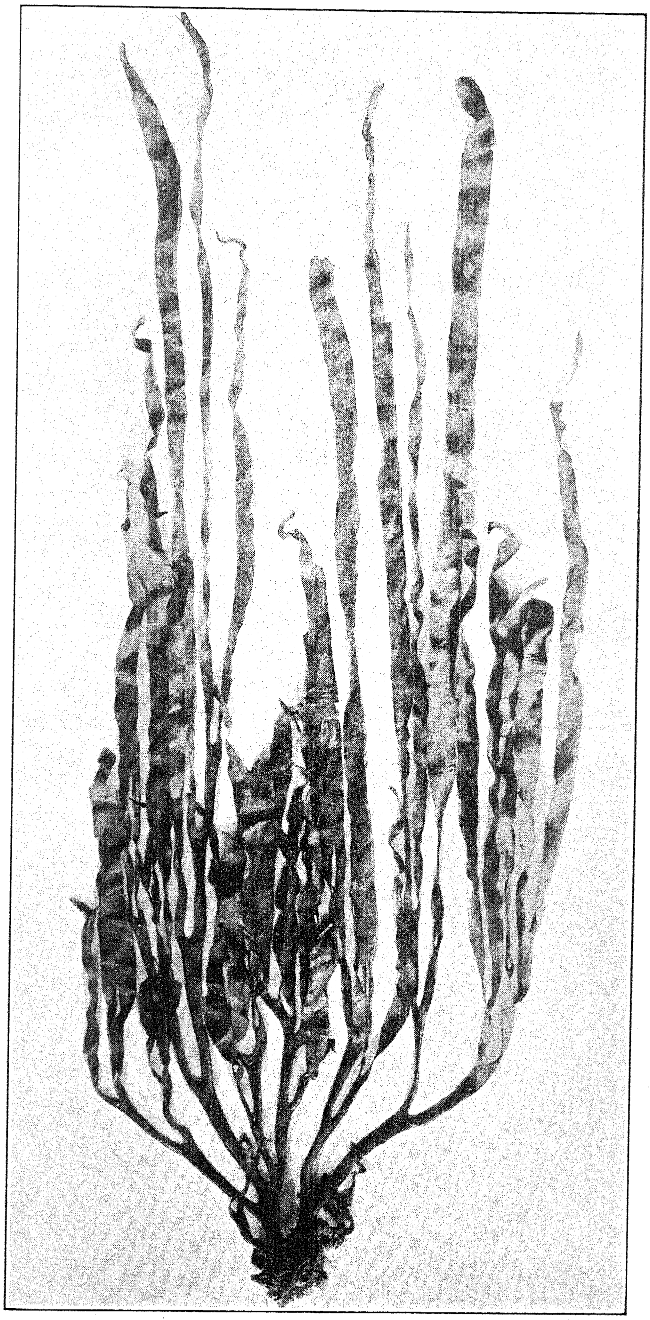

LESSONIA NIGRESCENS Bory

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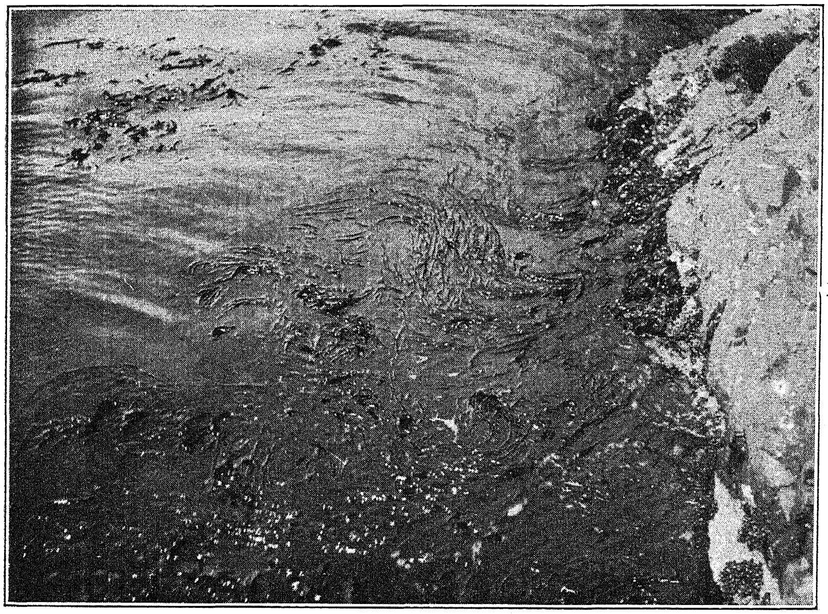
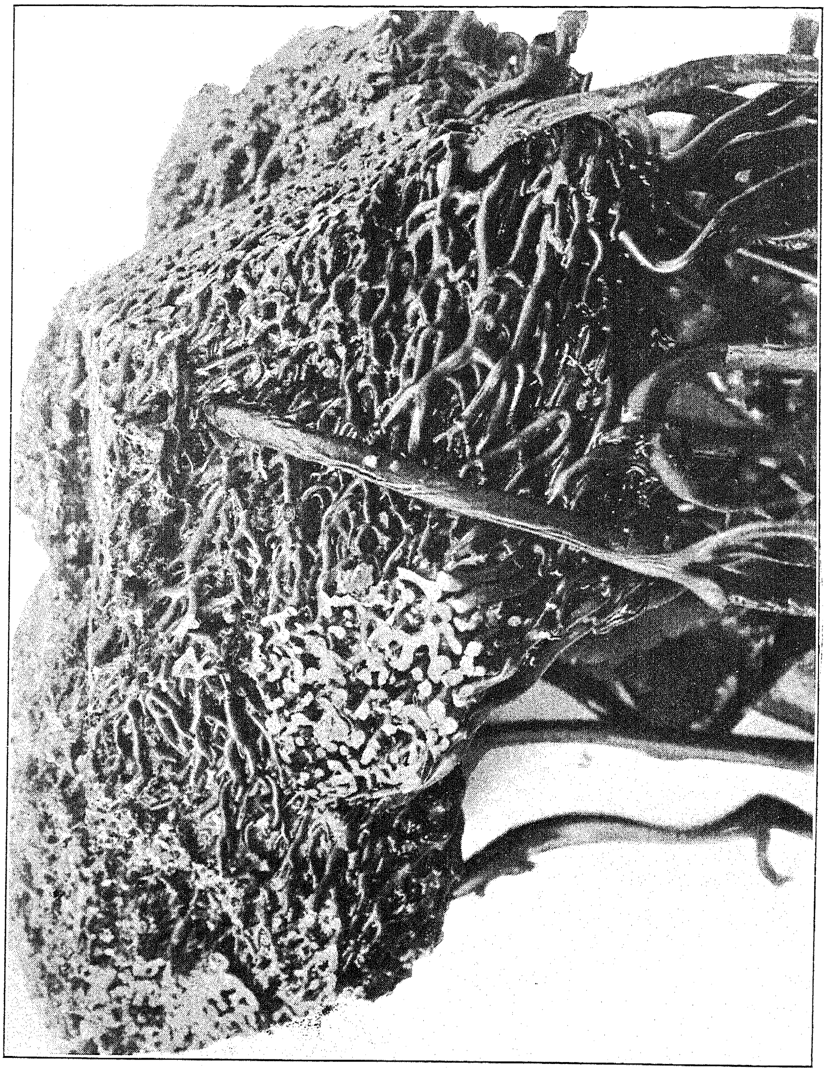
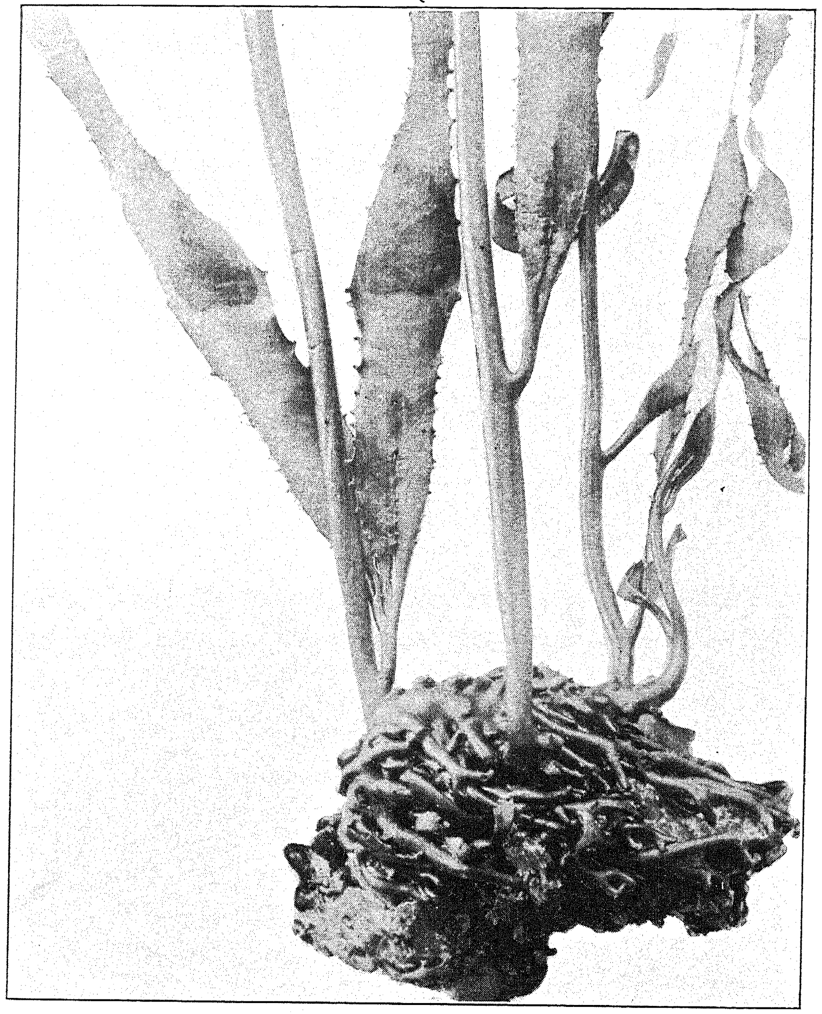


B

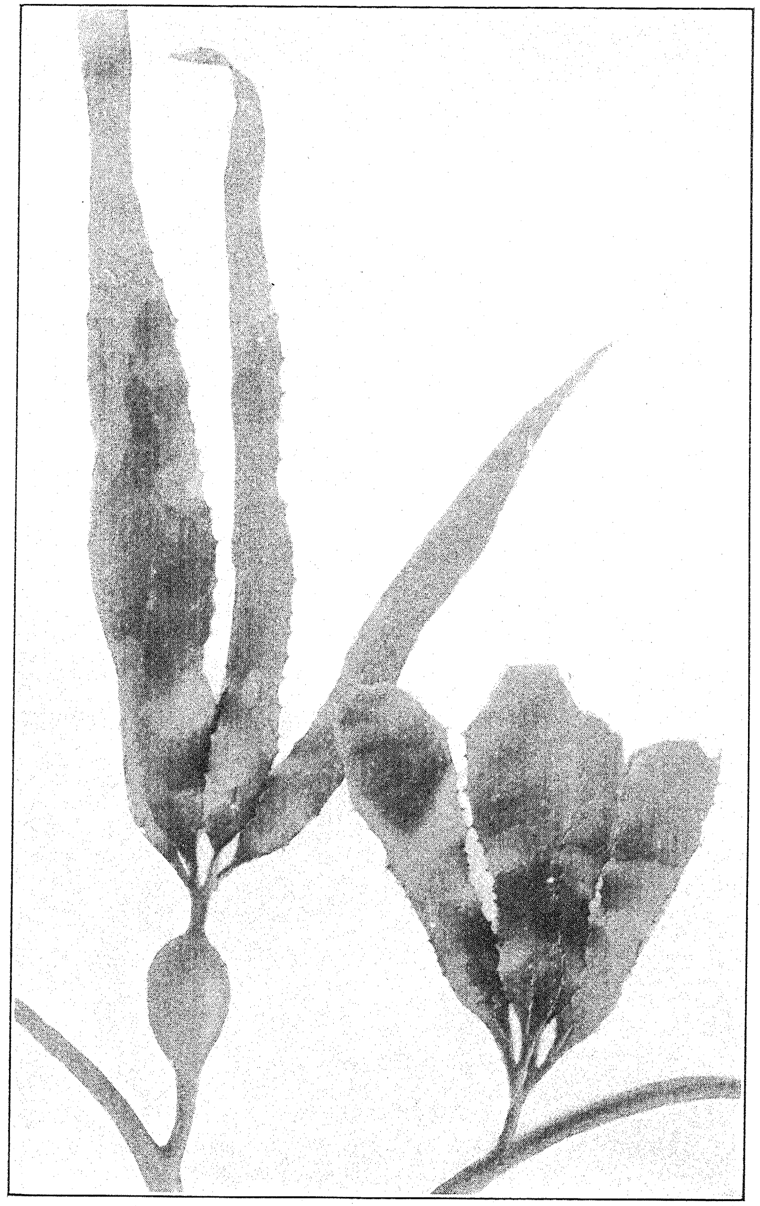
A. EISENIA COKERI M. A. Howe, washed ashore
B. MACROCYSTIS INTEGRIFOLIA Bory, *in situ*



Macrocystis integrifolia Bory



MACROCYSTIS INTEGRIFOLIA Bory



MACROCYSTIS INTEGRIFOLIA Bory

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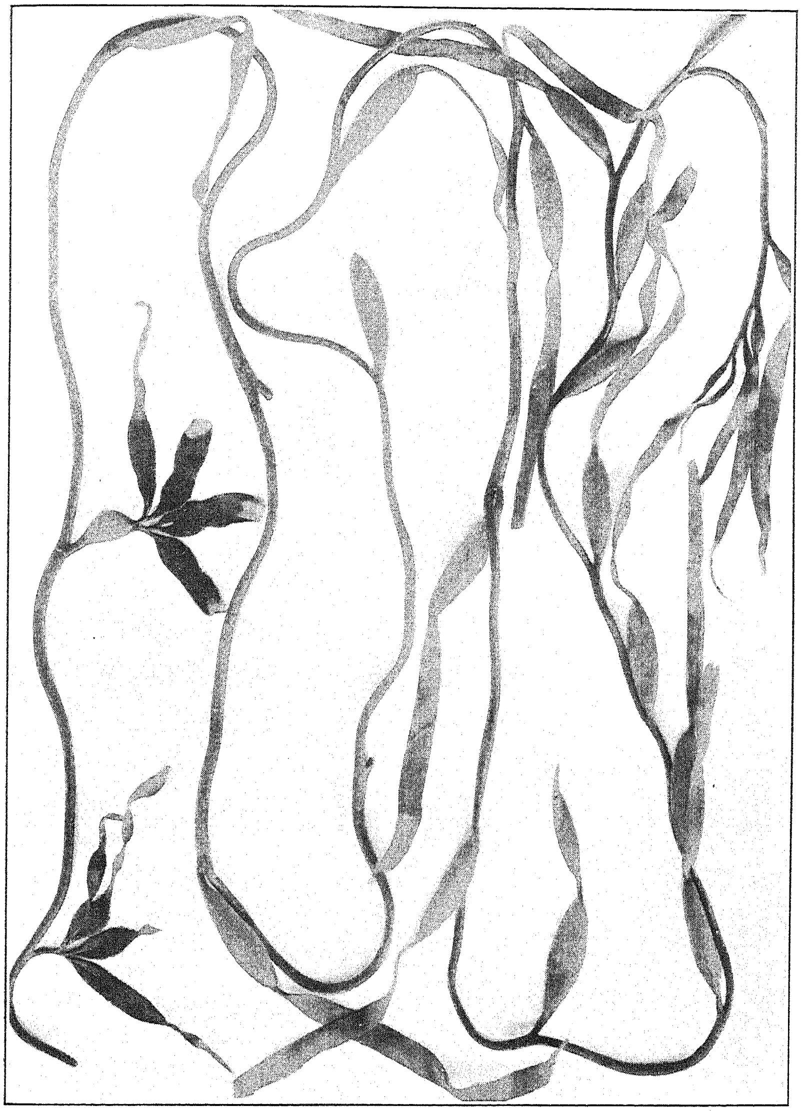

MACROCYSTIS INTEGRIFOLIA Bory

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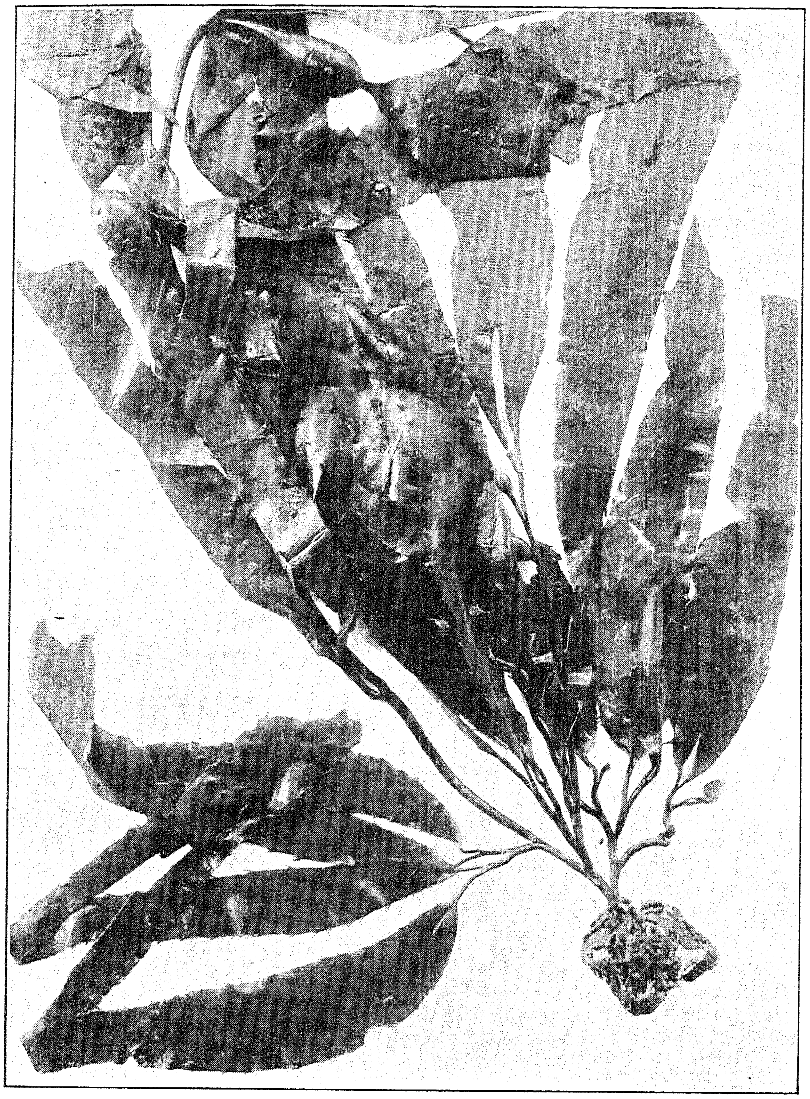

Macrocystis pyrifera Humboldtii (Bonpl.) Hook. f. & Harv.

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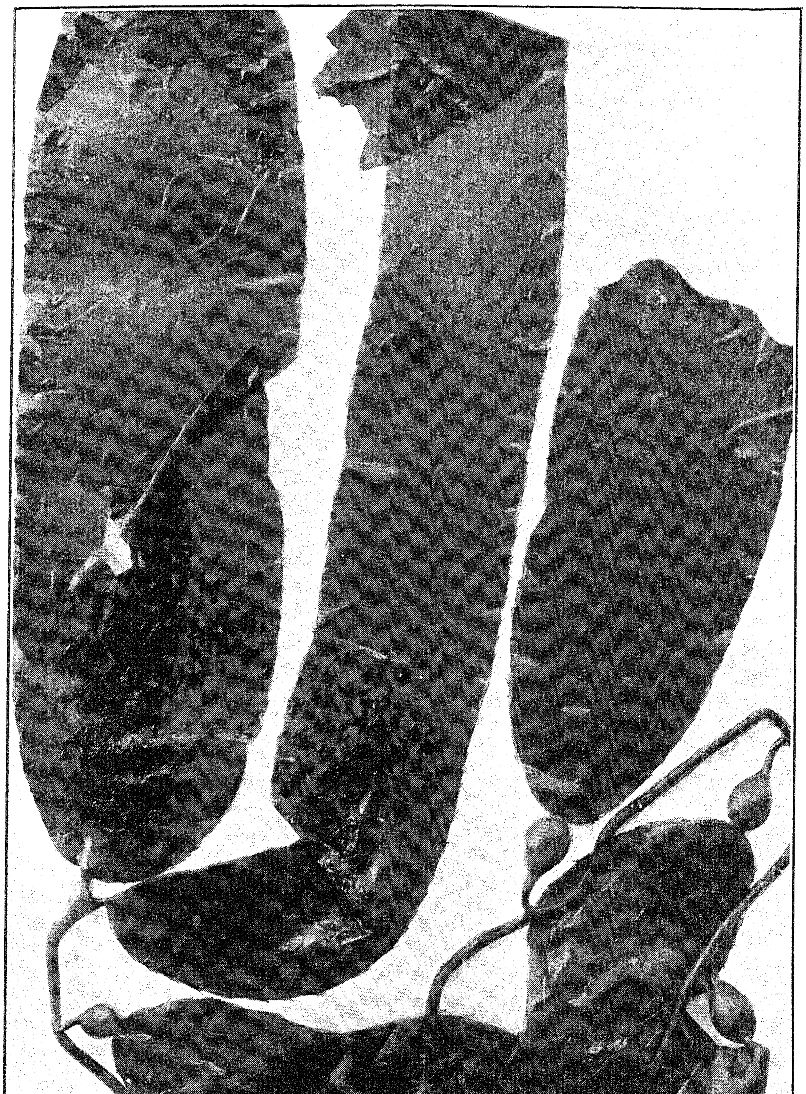

MACROCYSTIS PYRIFERA HUMBOLDTII (Bonpl.) Hook. f. & Harv.

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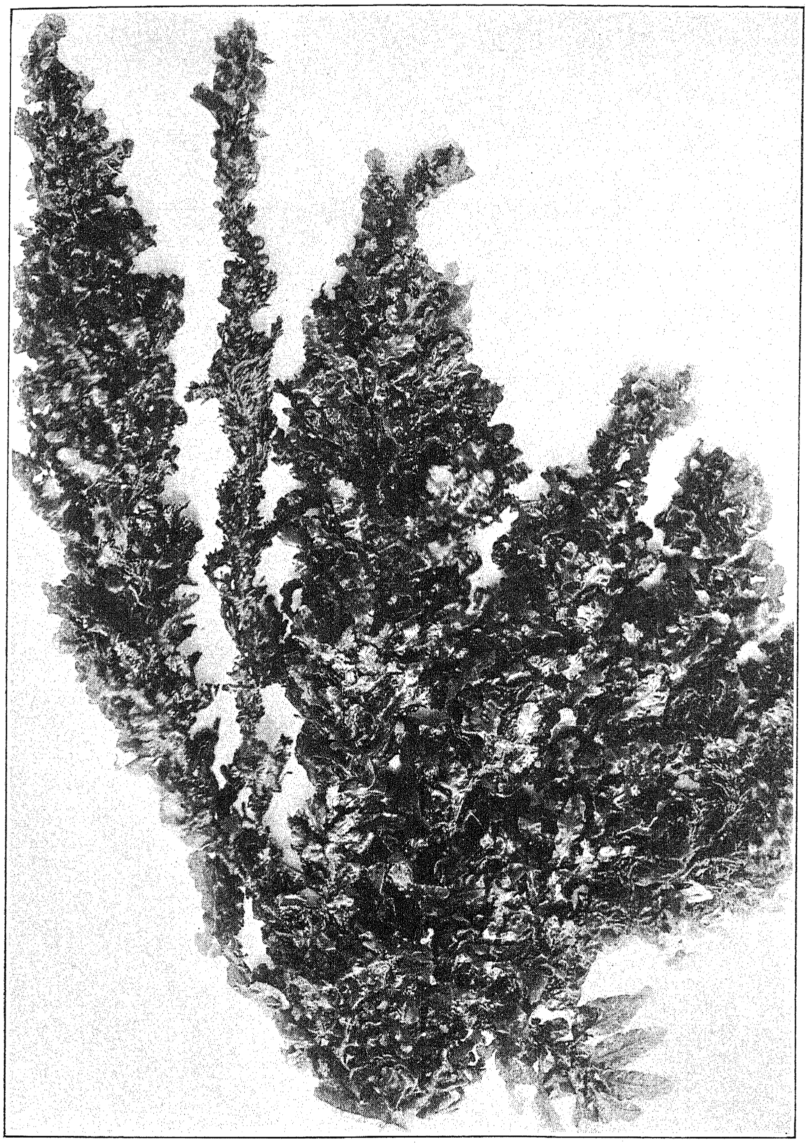

Sargassum pacificum Bory

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SPATOGLOSSUM CRISPATUM M. A. Howe

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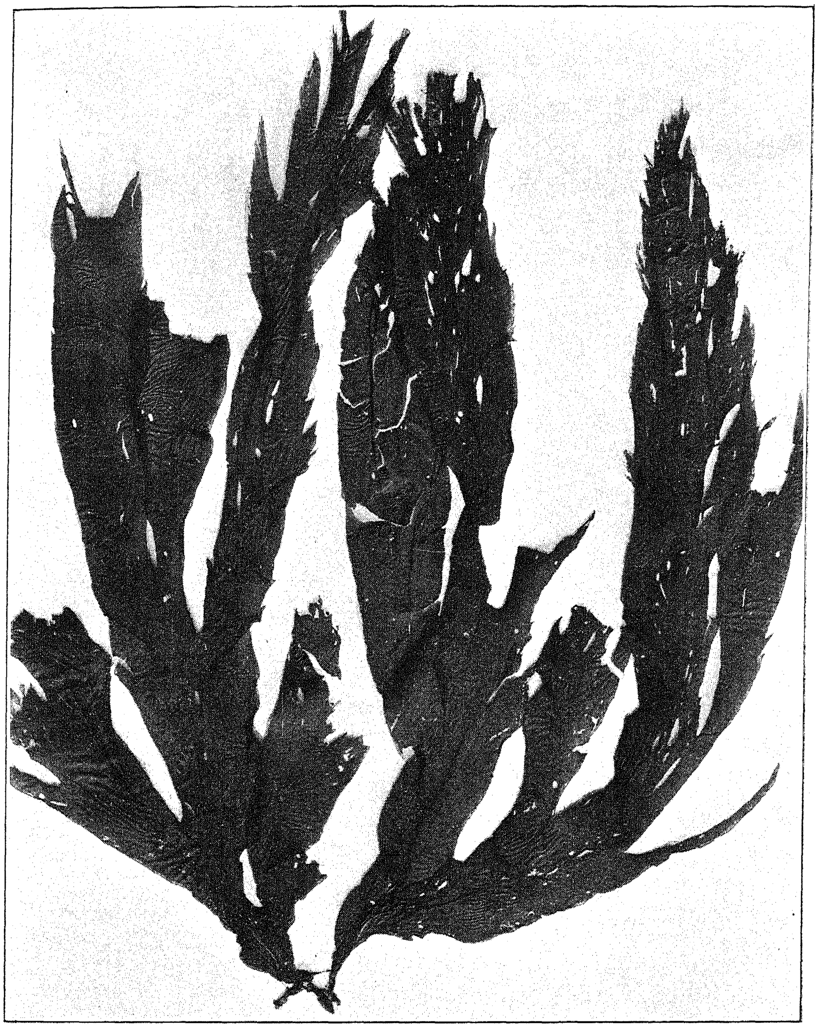

Neurocarpus Cokeri M. A. Howe

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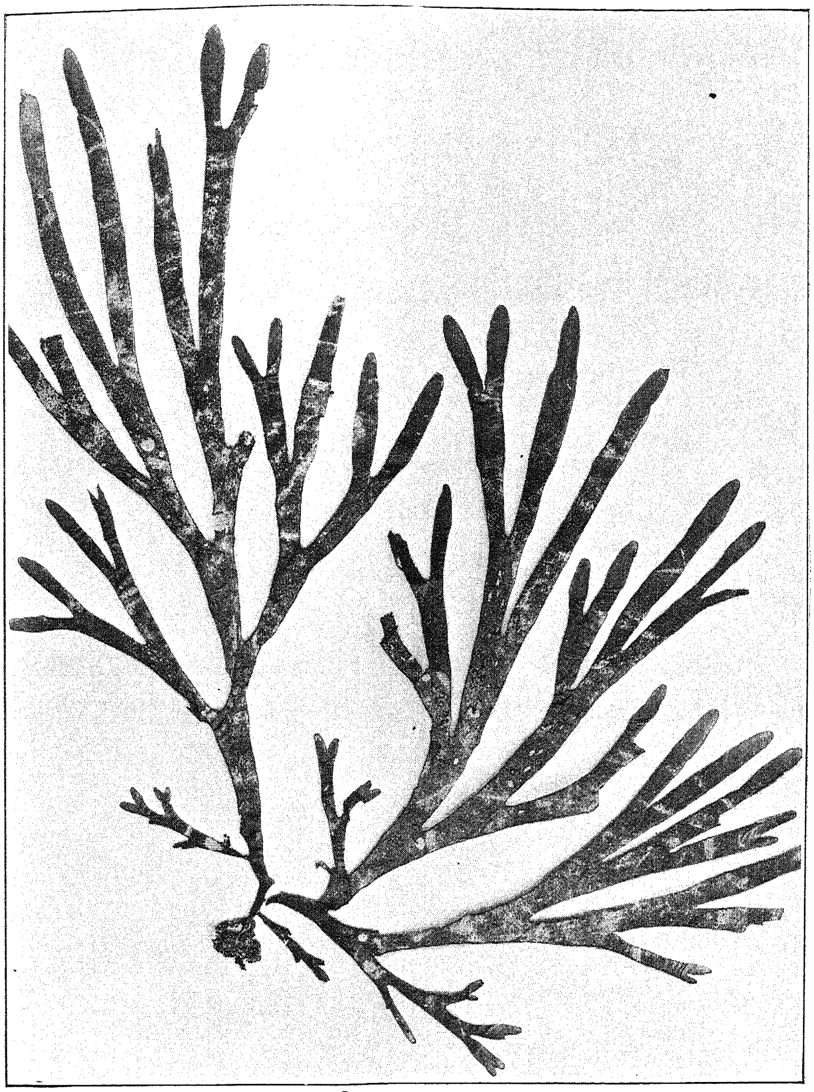

Glossophora Kunthii (Ag.) J. Ag.

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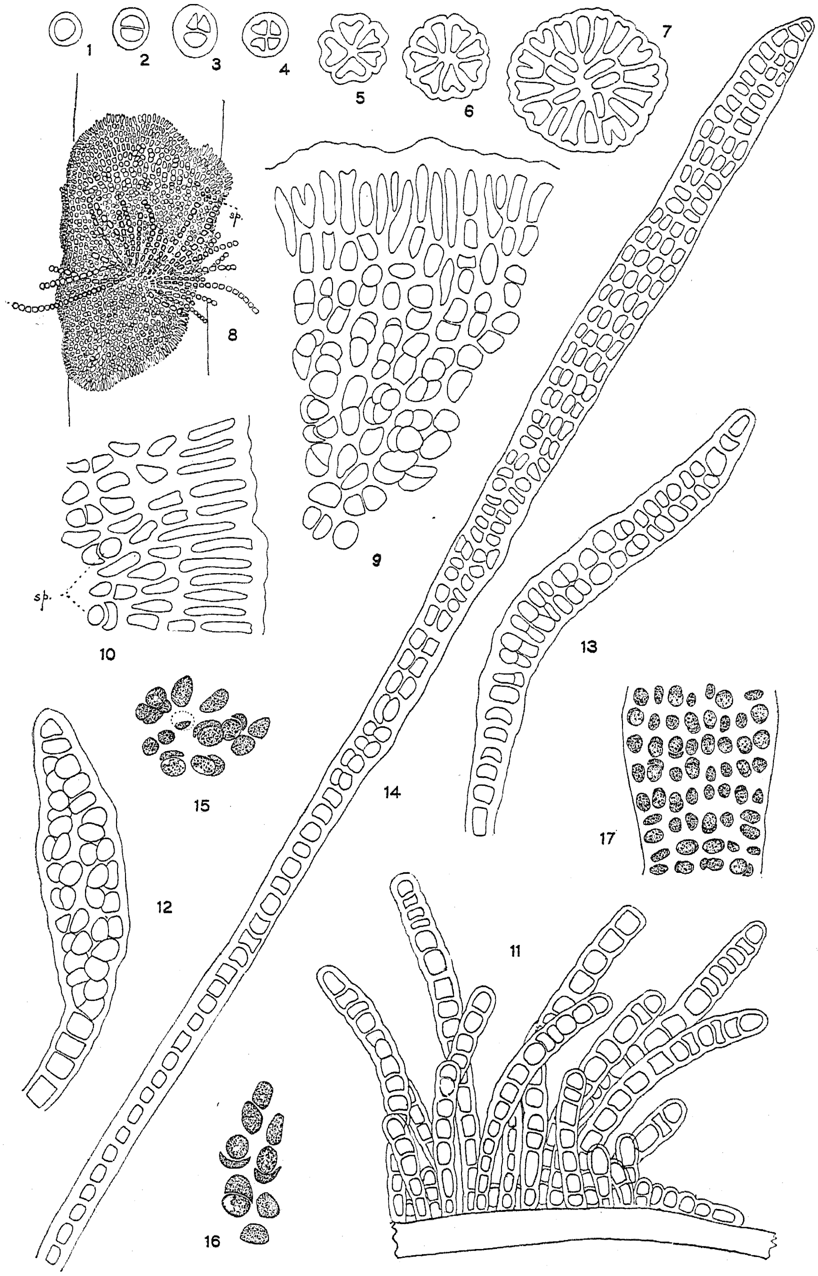
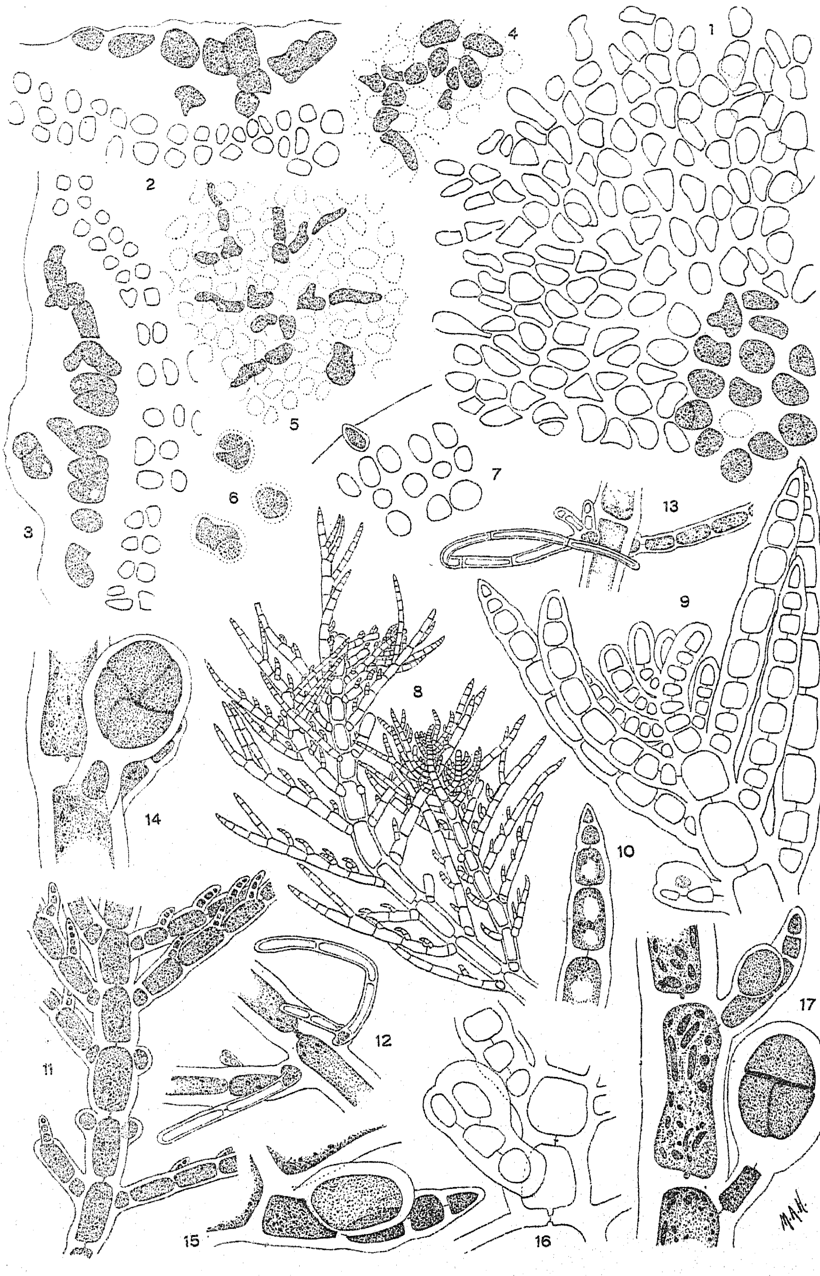


ERYTHROTRICHIA POLYMORPHA M. A. Howe



1-7. ERYTHROCLADIA ENDOPHLOEA M. A. Howe

8-17. ANTITHAMNION DENSUM (Suhr) M. A. Howe

HELIOTYPE CO., BOSTON

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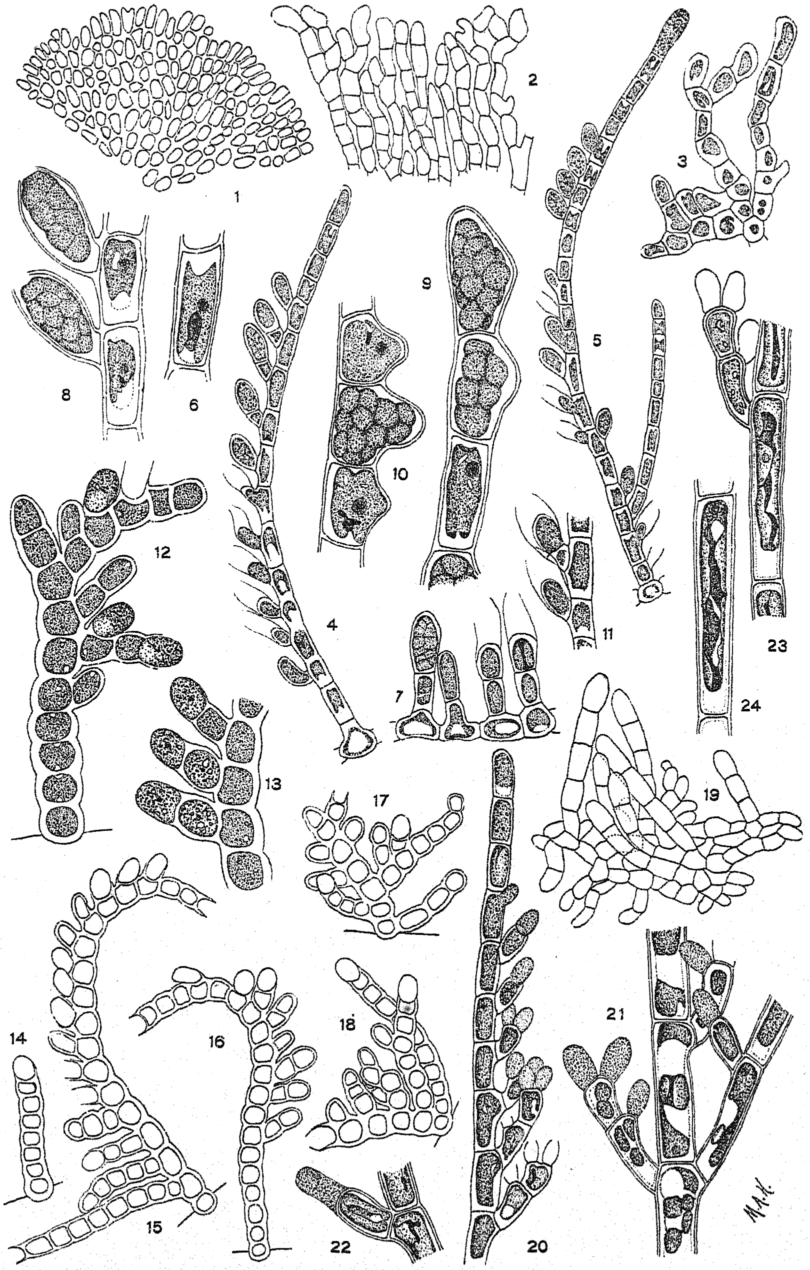
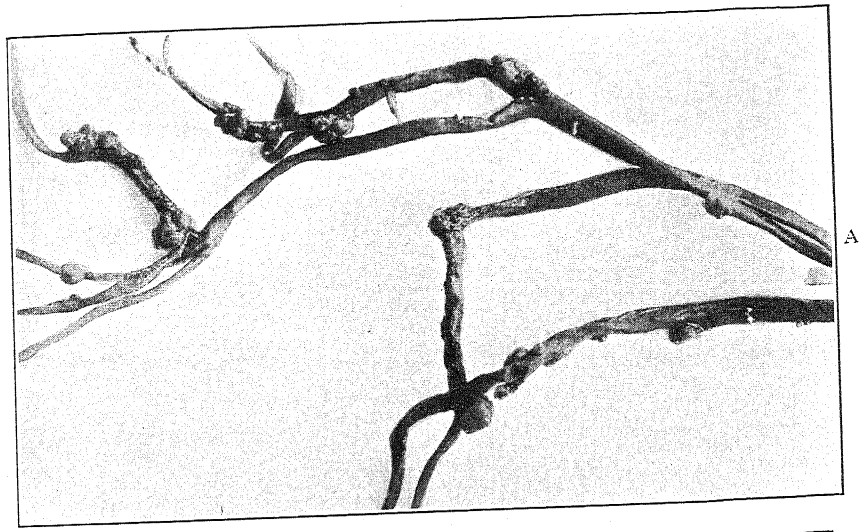


1-11. ACROCHAETIUM POLYSPORUM M. A. Howe
12-18. ACROCHAETIUM CATENULATUM M. A. Howe
19-24. ACROCHAETIUM CLANDESTINUM (Mont.) M. A. Howe

HELIOTYPE CO., BOSTON



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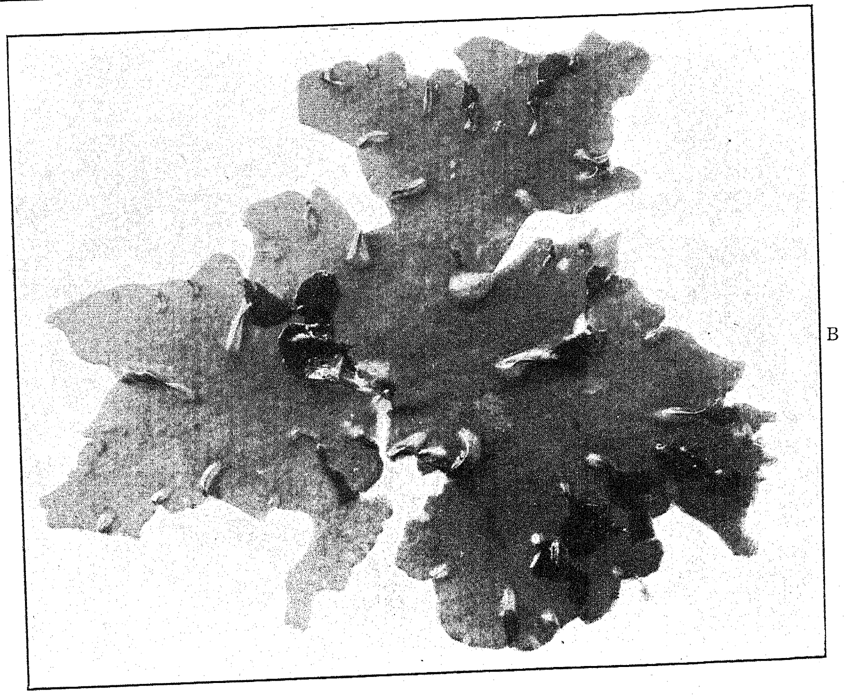
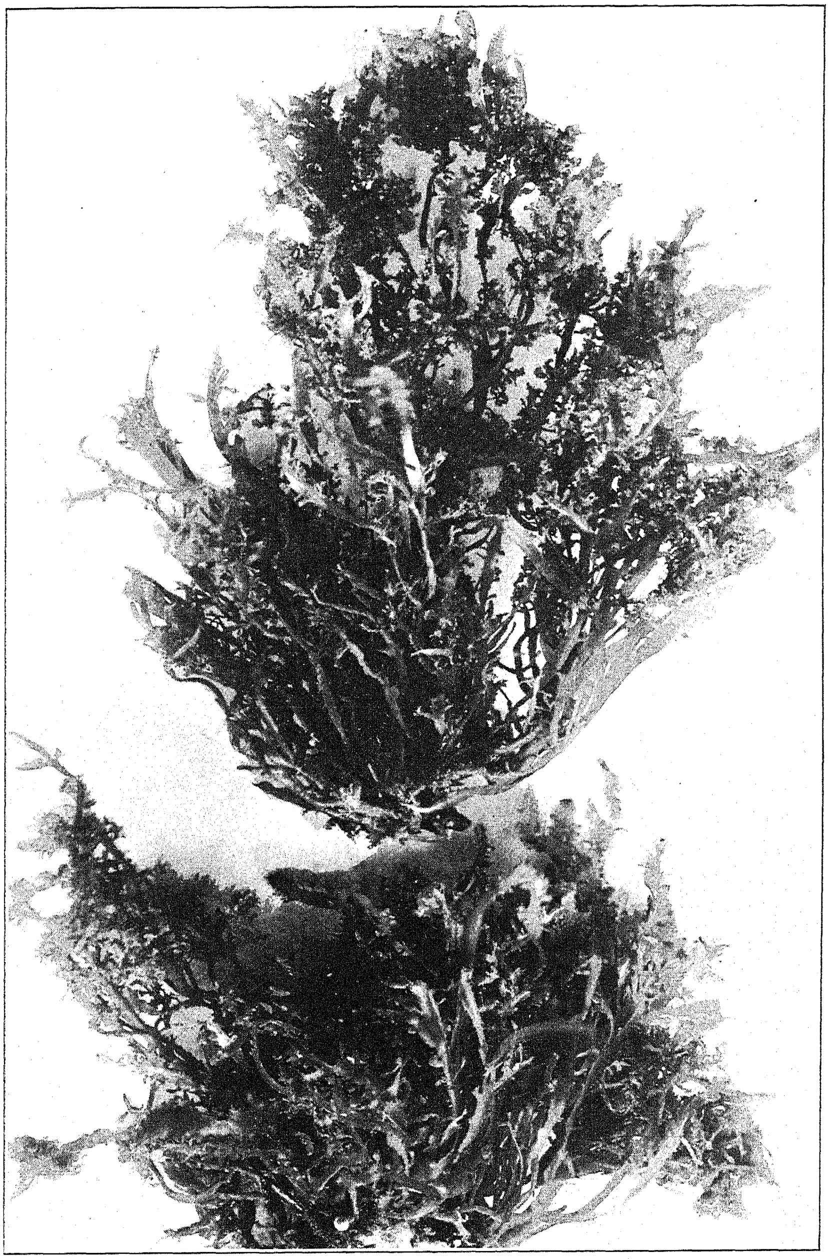


B

A. Lobocolax deformans M. A. Howe
B. Callophyllis chilensis (J. Ag.) Okam.



GELIDIUM CRISPUM M. A. Howe

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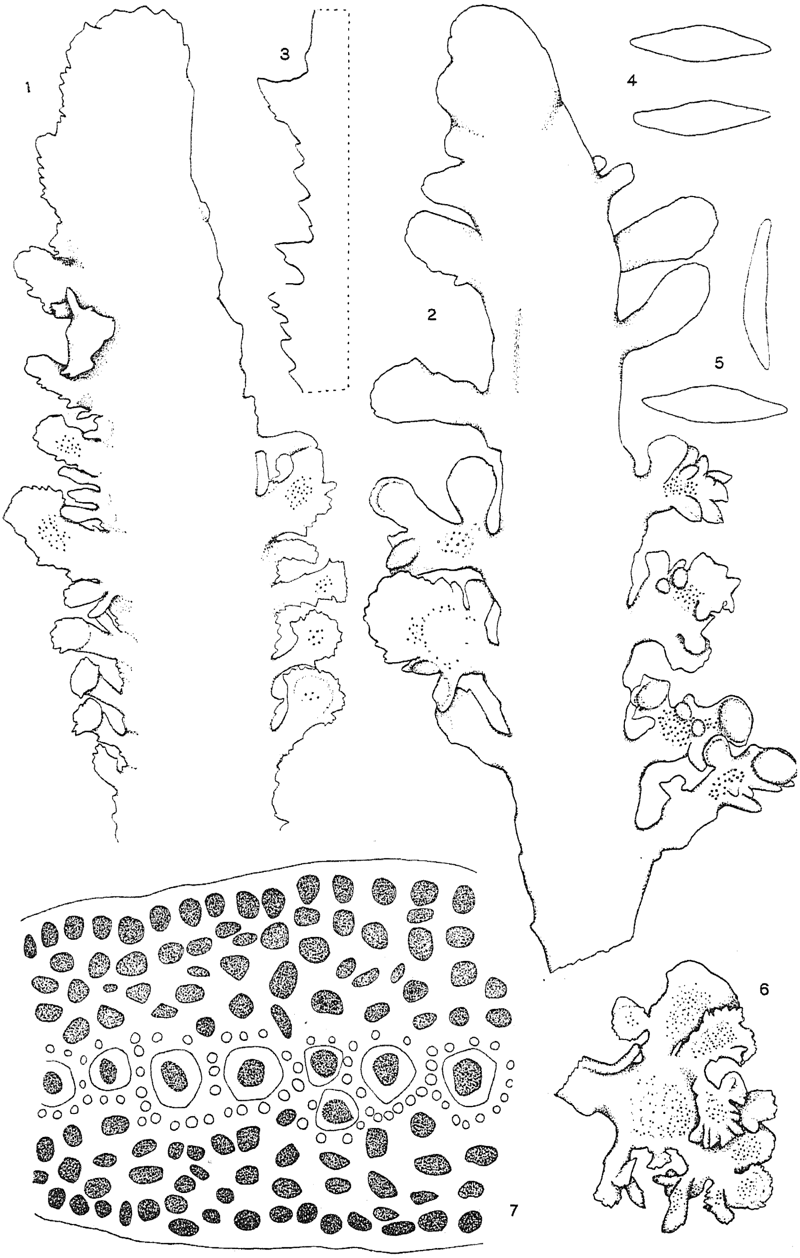
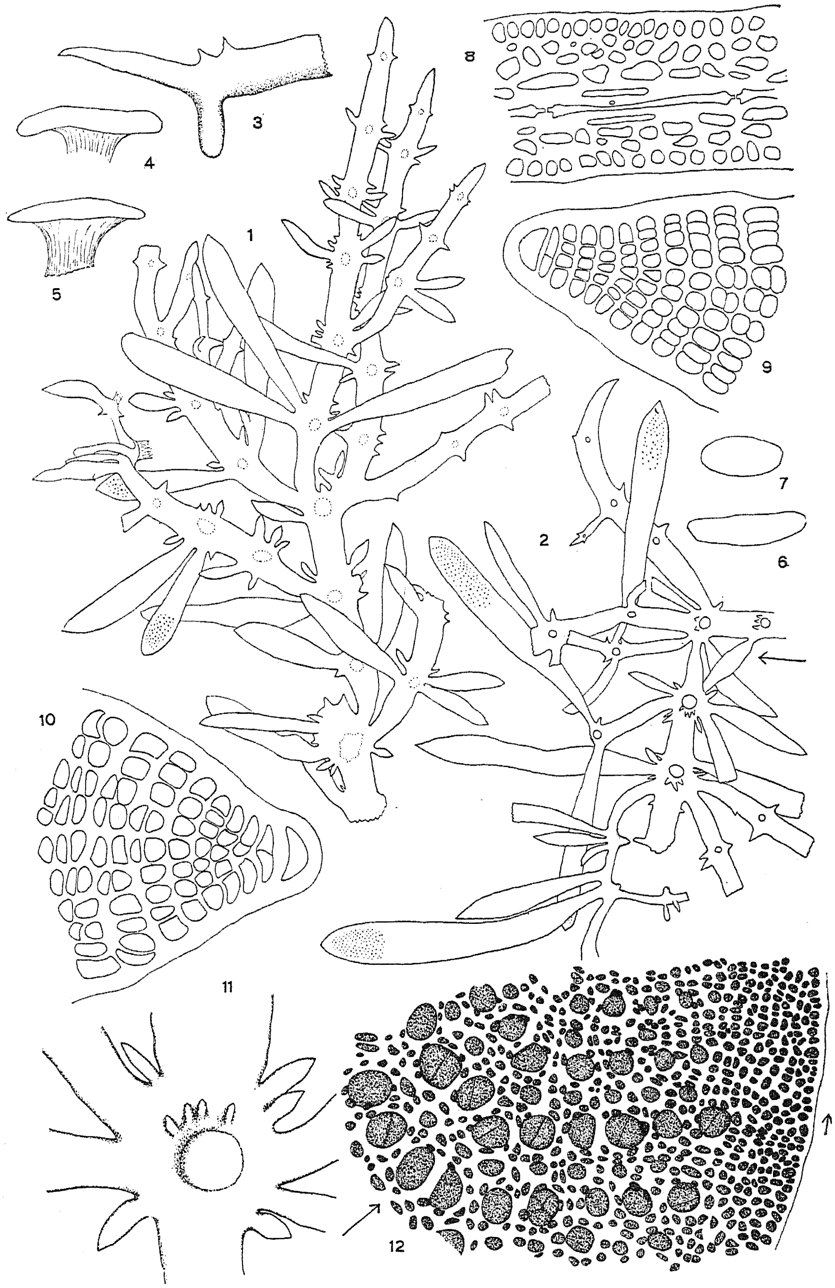
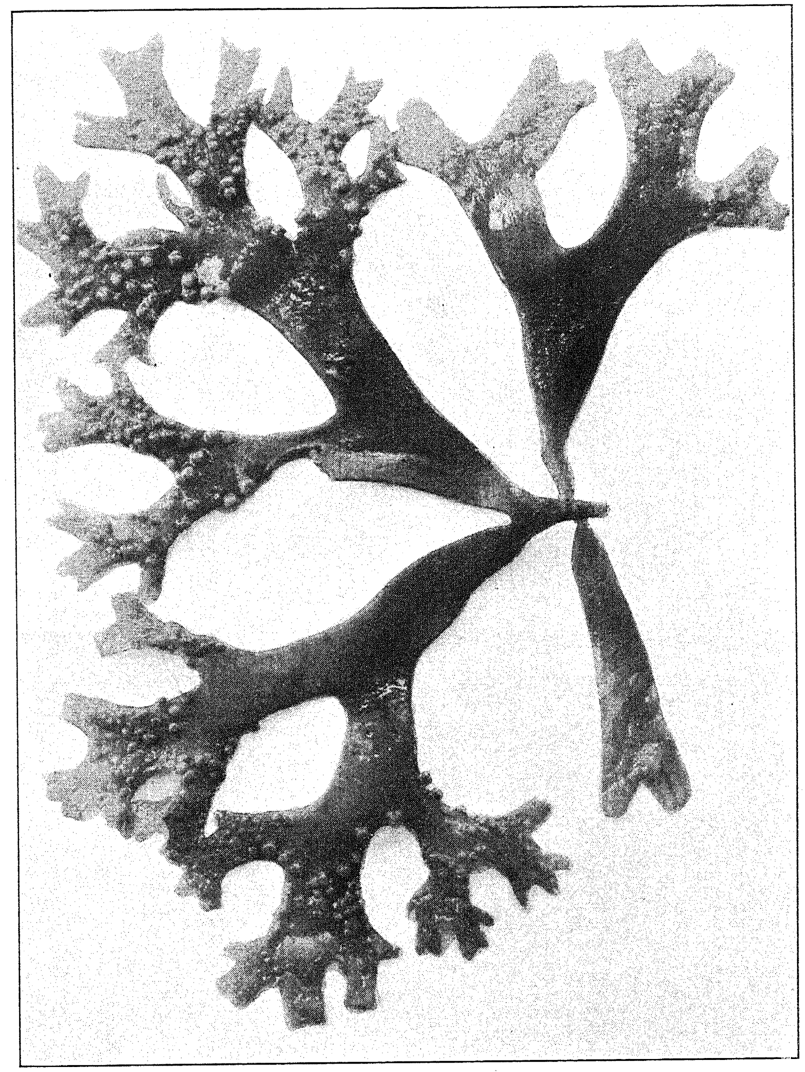


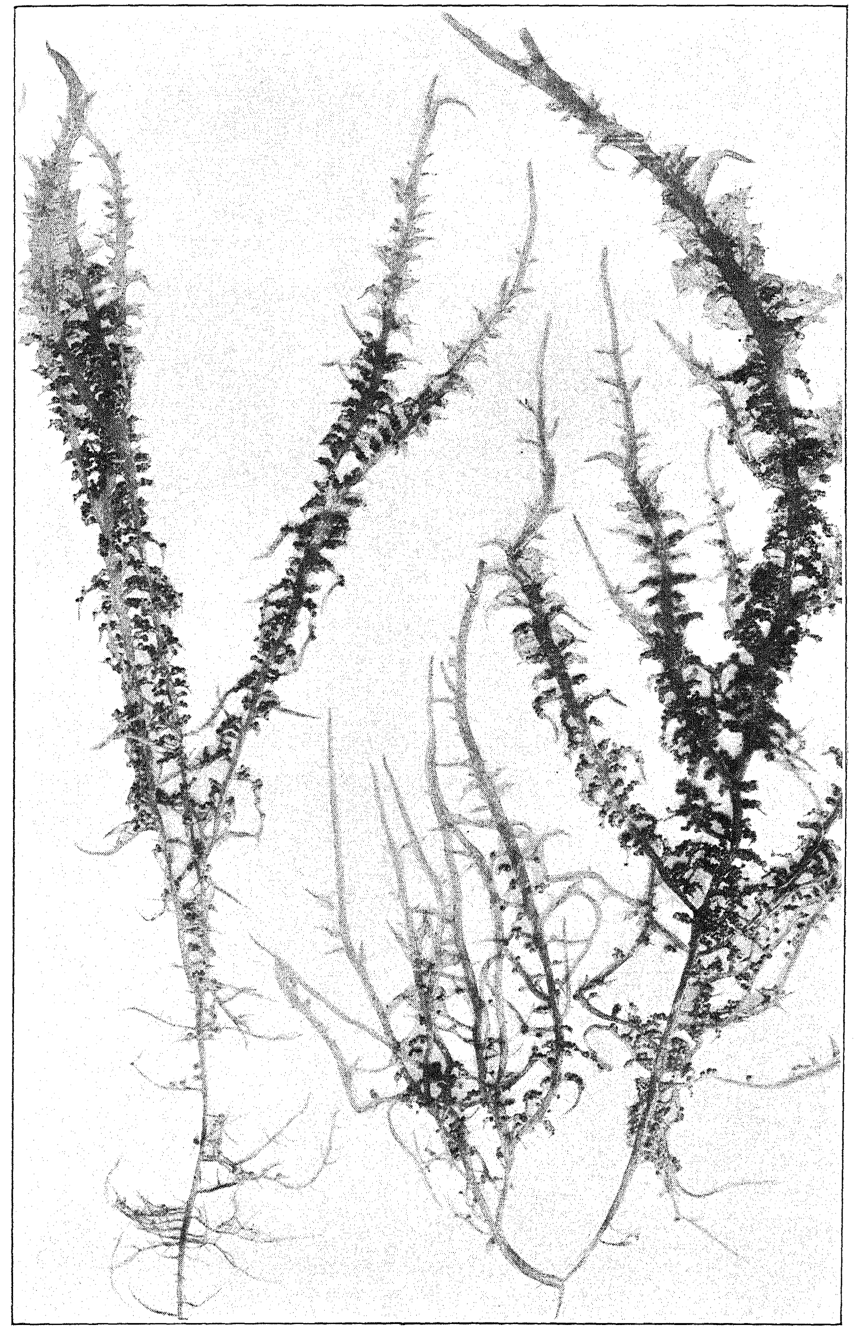
1–6. GELIDIUM CRISPUM M. A. Howe
7. GELIDIUM CALOGLOSSOIDES M. A. Howe



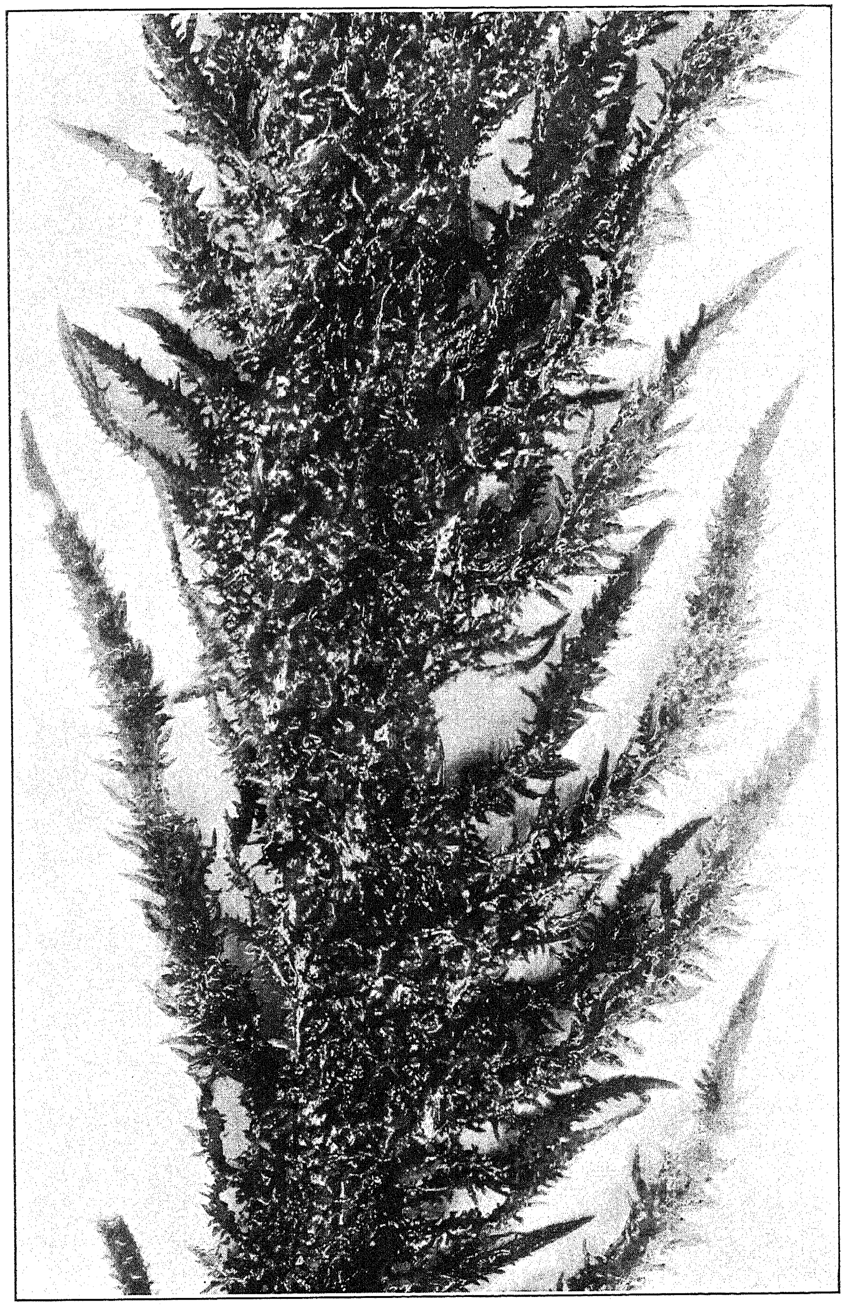
GELIDIUM CALOGLOSSOIDES M. A. Howe



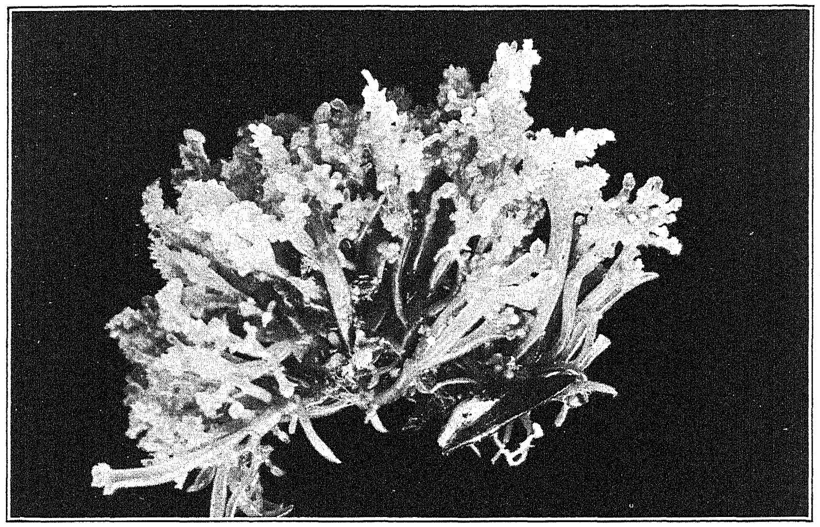
CHONDRUS CANALICULATUS (Ag.) Grev.



GIGARTINA LESSONII (Bory) J. Ag.



Gigartina Chauvinii (Bory) Mont.



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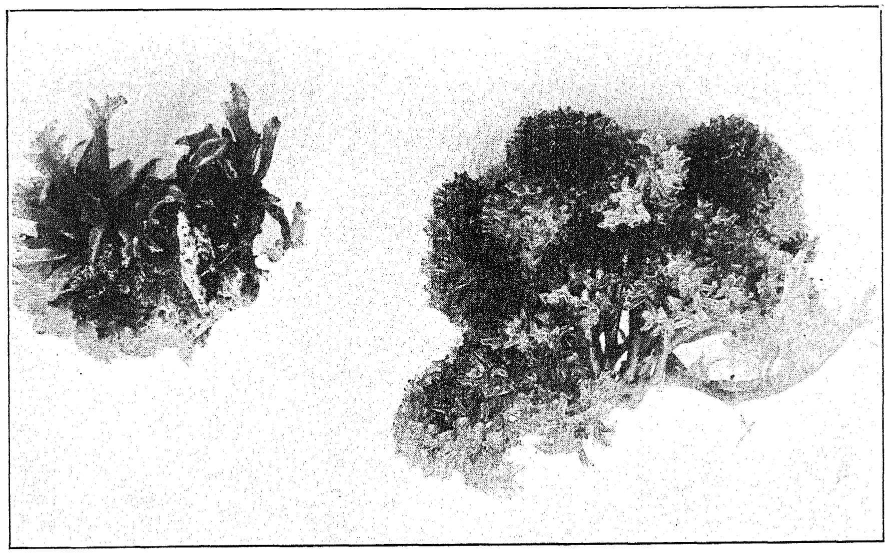

B

Gigartina glomerata M. A. Howe

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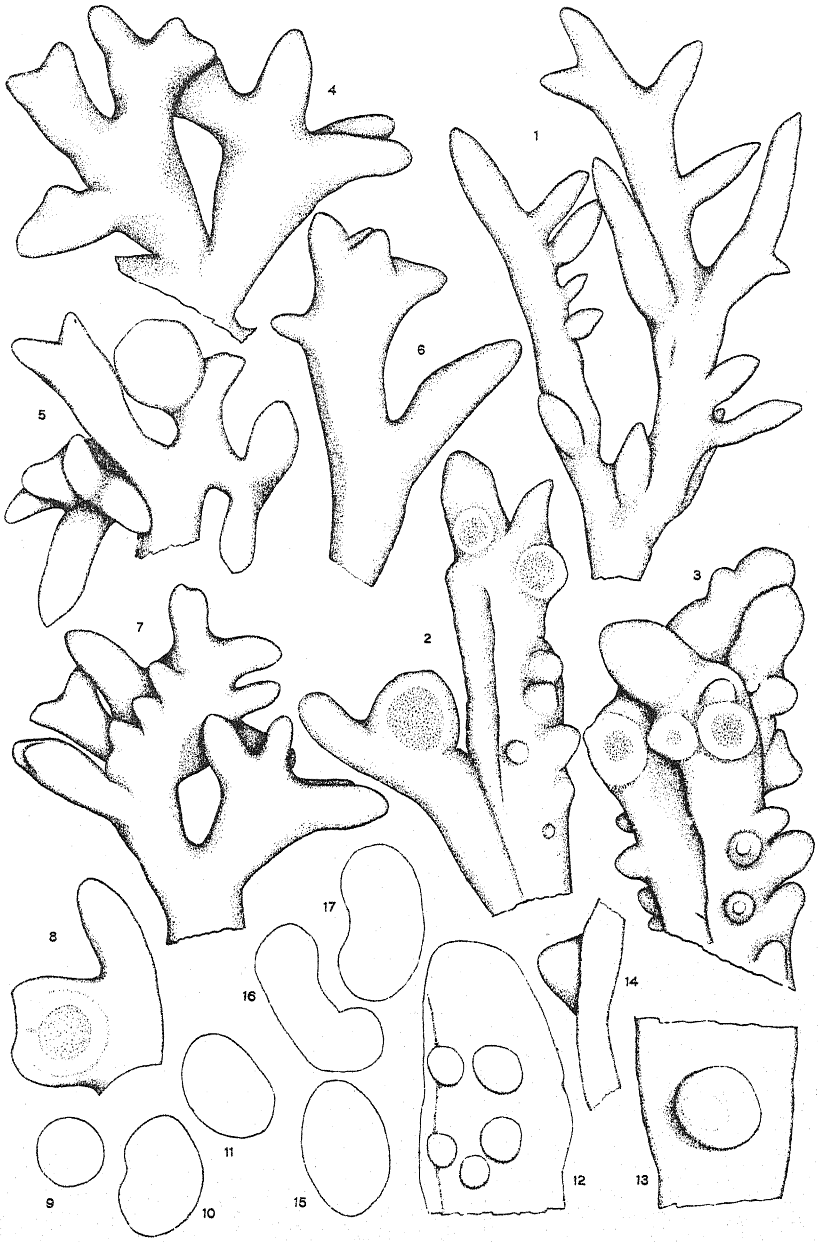

1-11. GIGARTINA GLOMERATA M. A. Howe

12-17. GIGARTINA TUBERCULOSA (Hook. f. & Harv.) GRUN.

HELIOTYPE CO., BOSTON

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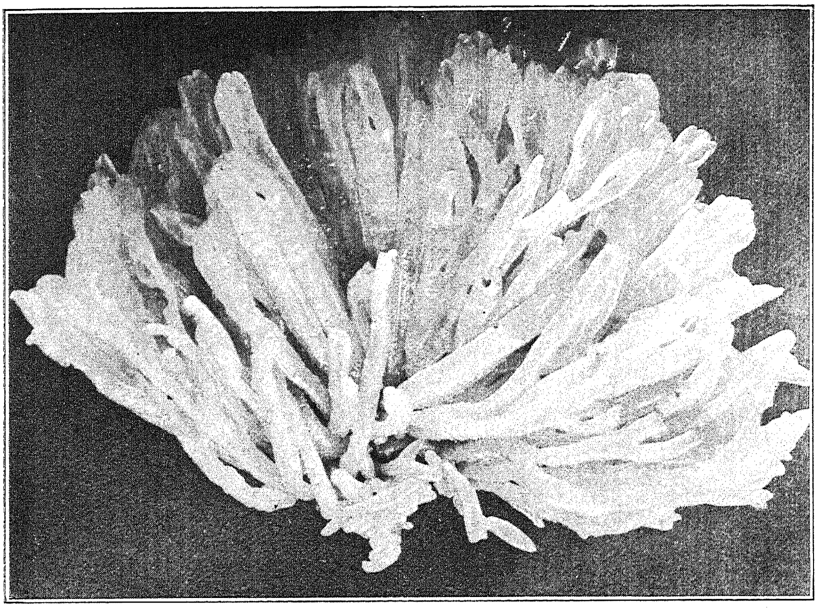

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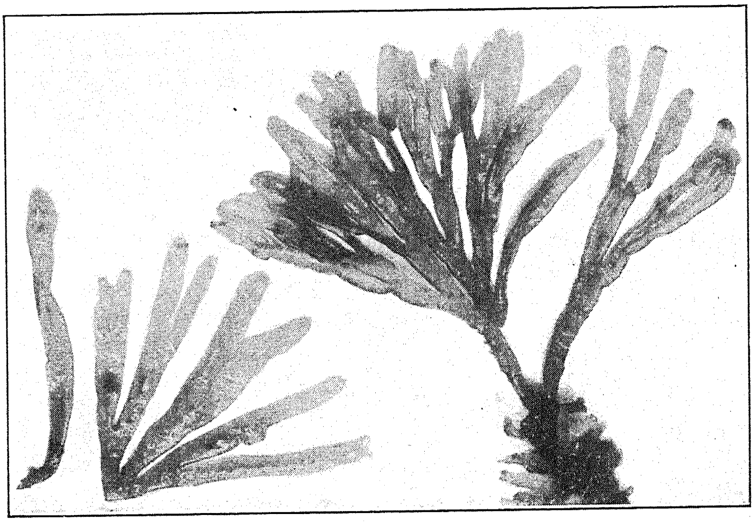

B

GIGARTINA TUBERCULOSA (Hook. f. & Harv.) Grun.

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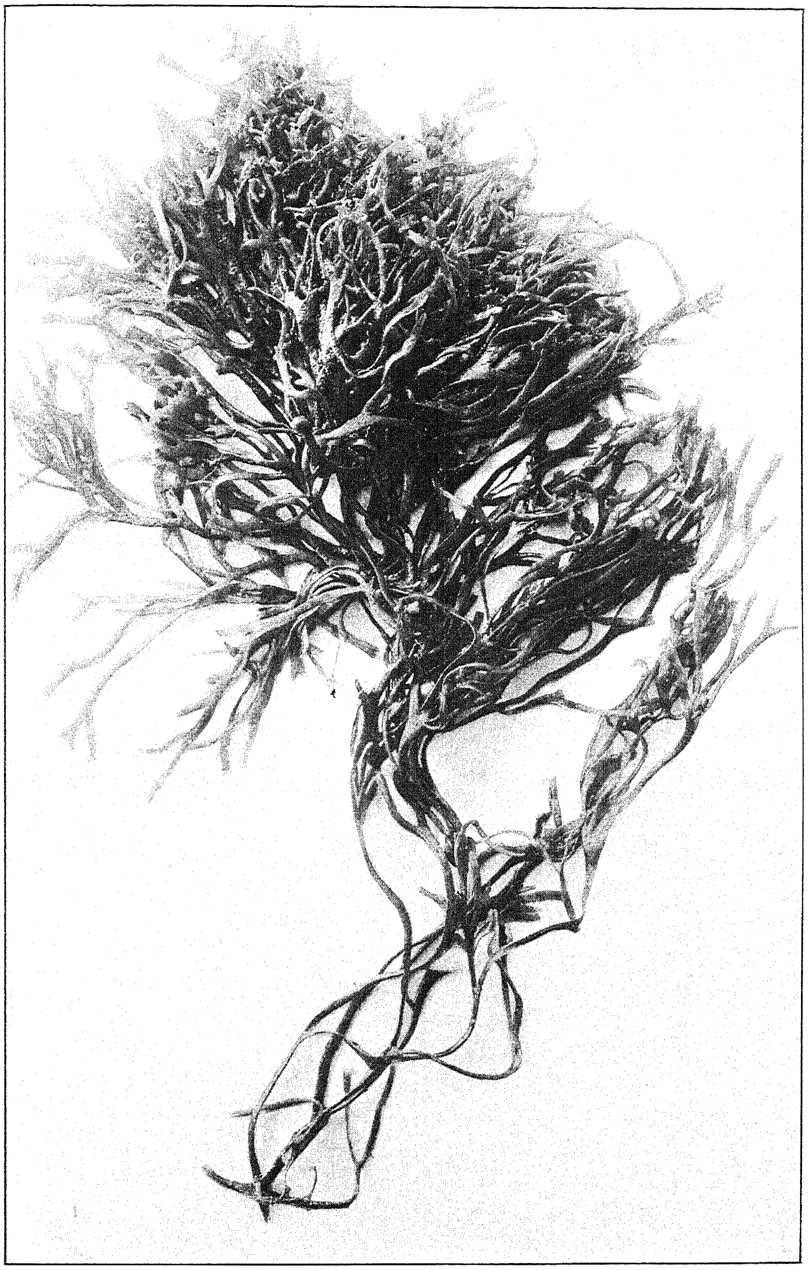

Gymnogongrus furcellatus (Ag.) J. Ag.

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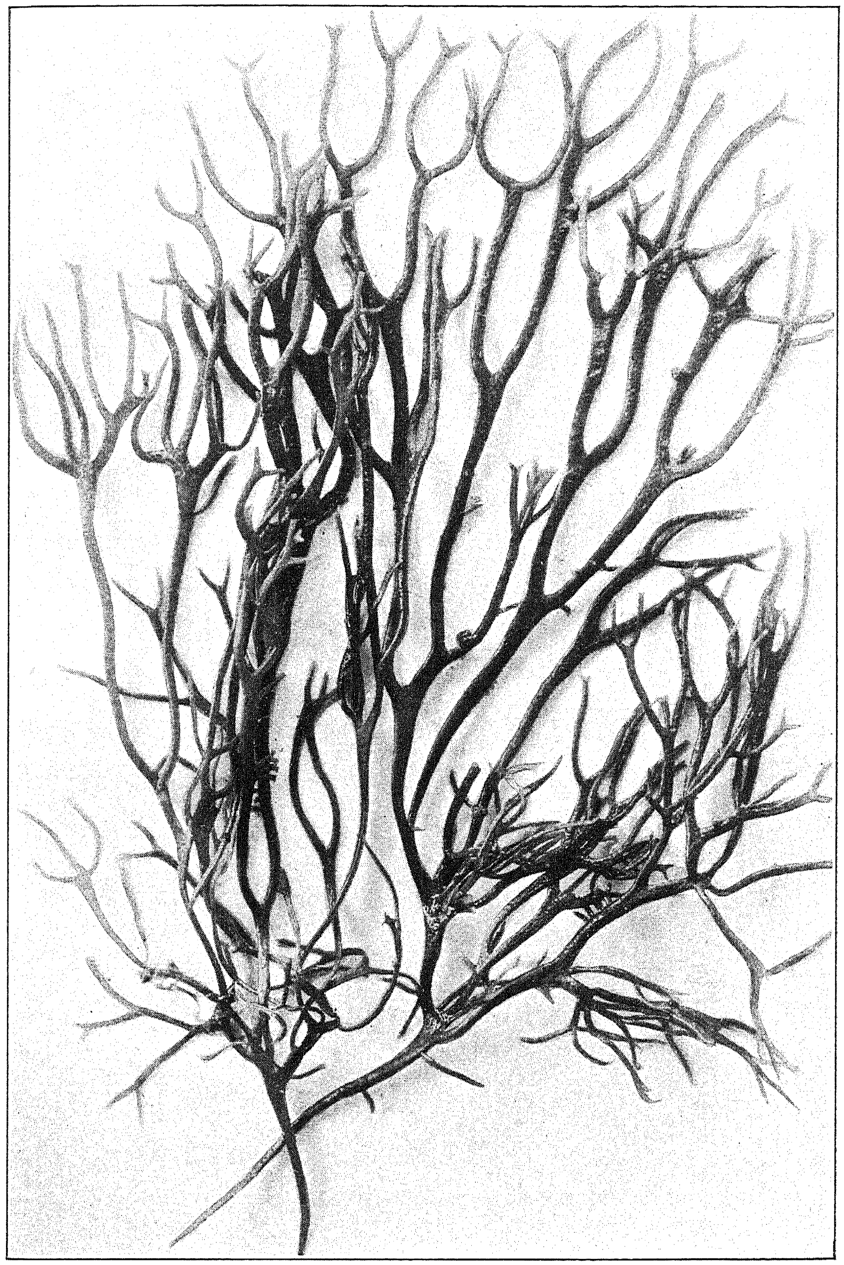

GYMNOGONGRUS DISCIPLINALIS (Bory) J. Ag.
and
ACTINOCOCCUS MOLLIS M. A. Howe

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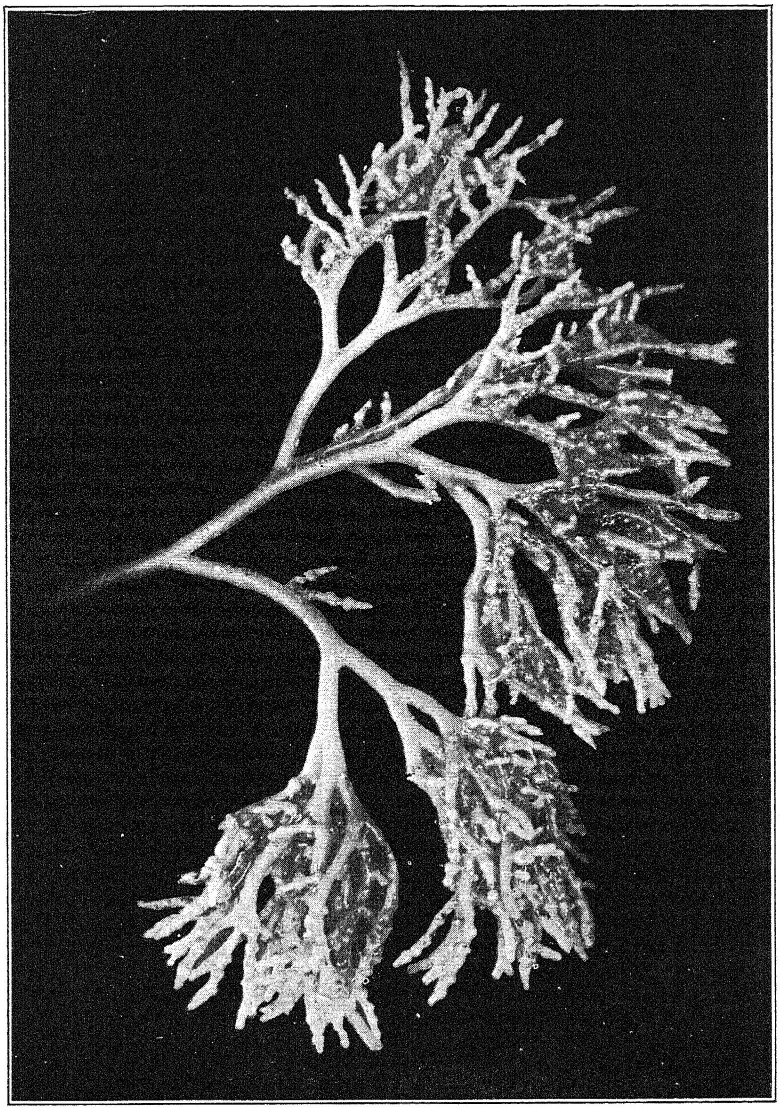

Ahnfeltia Durvillaei (Bory) J. Ag.

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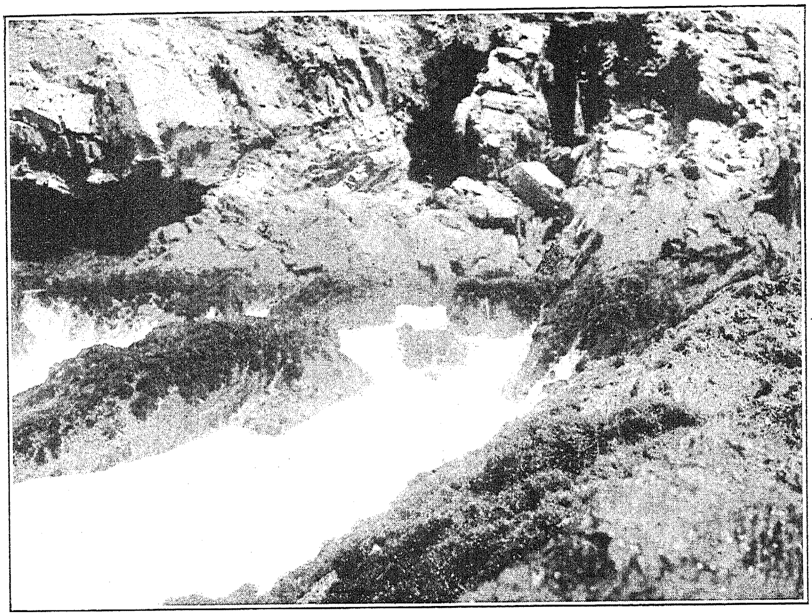

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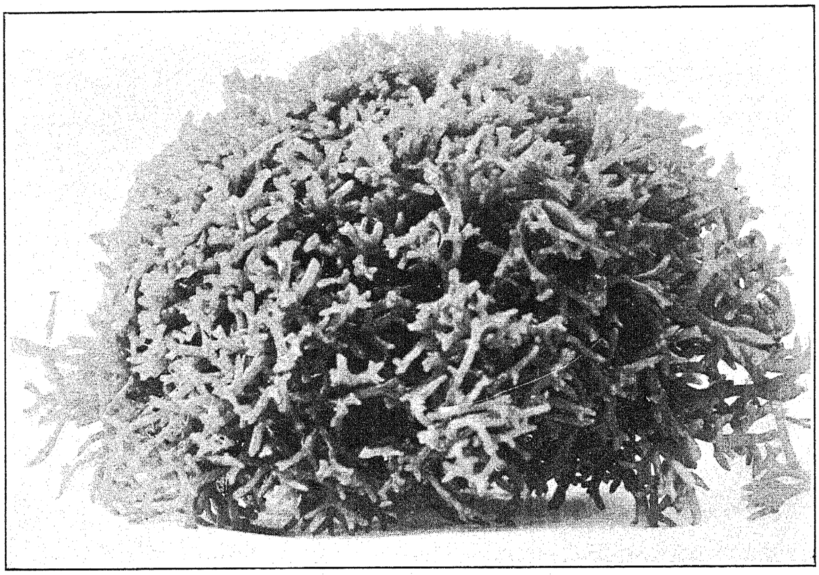

B

A. AHNFELTIA DURVILLAEI (Bory) J. Ag. *in situ* at Lobos de Afuera
B. AHNFELTIA DURVILLAEI IMPLICATA (Kütz.) M. A. Howe

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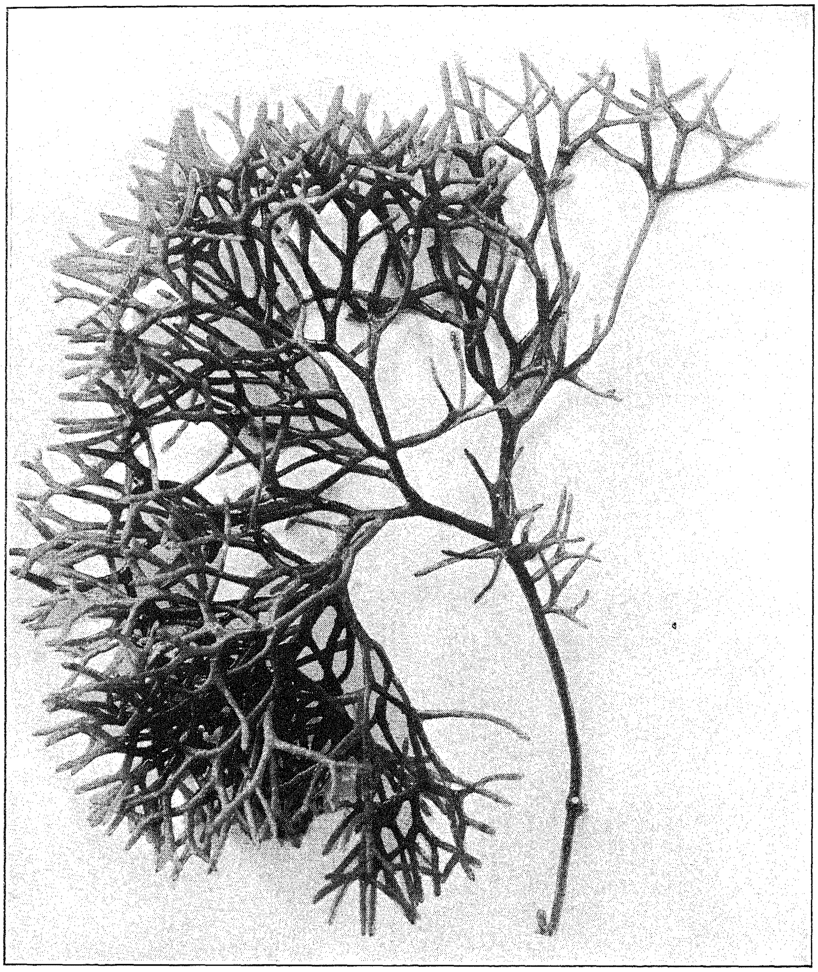

AHNFELTIA DURVILLAEI (Bory) J. Ag.

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AGARDHIELLA TENERA (J. Ag.) Schmitz

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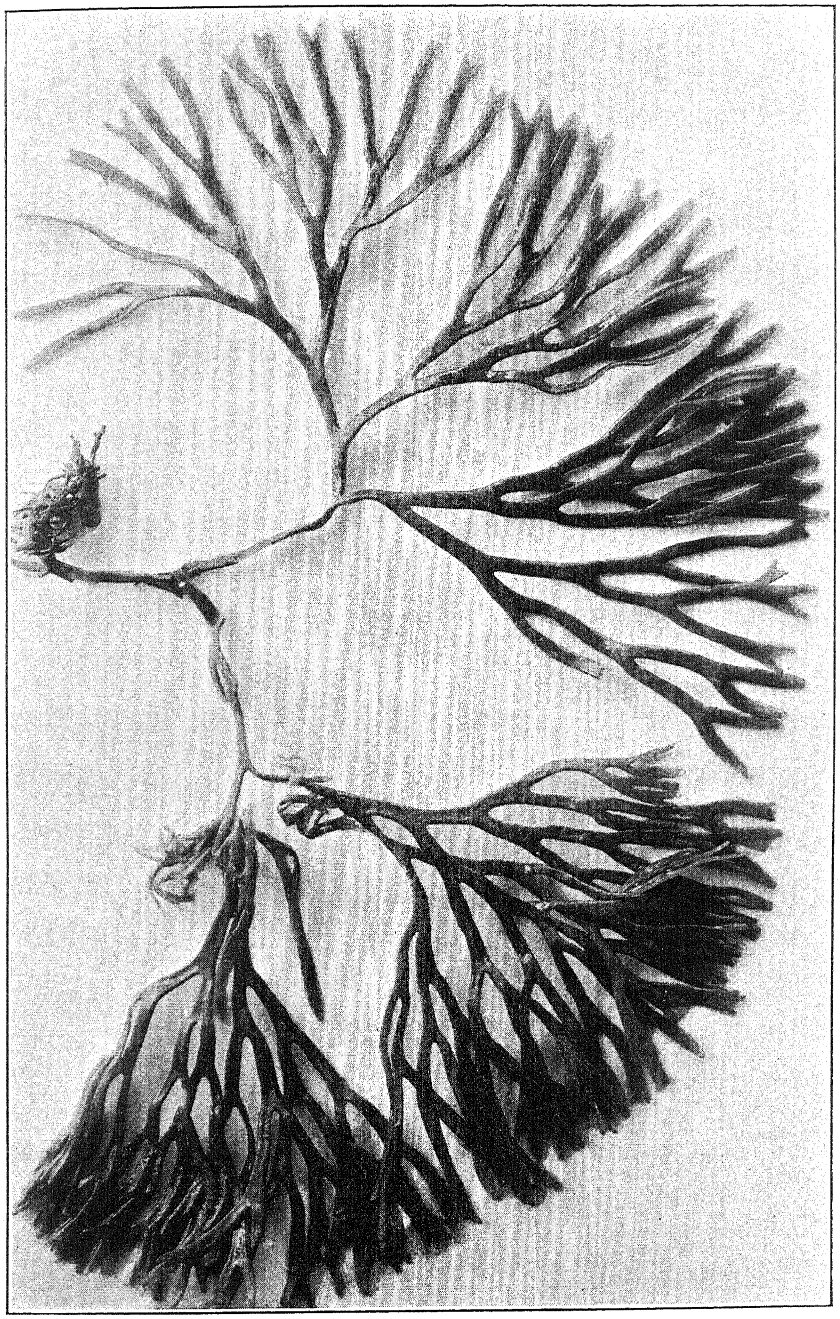
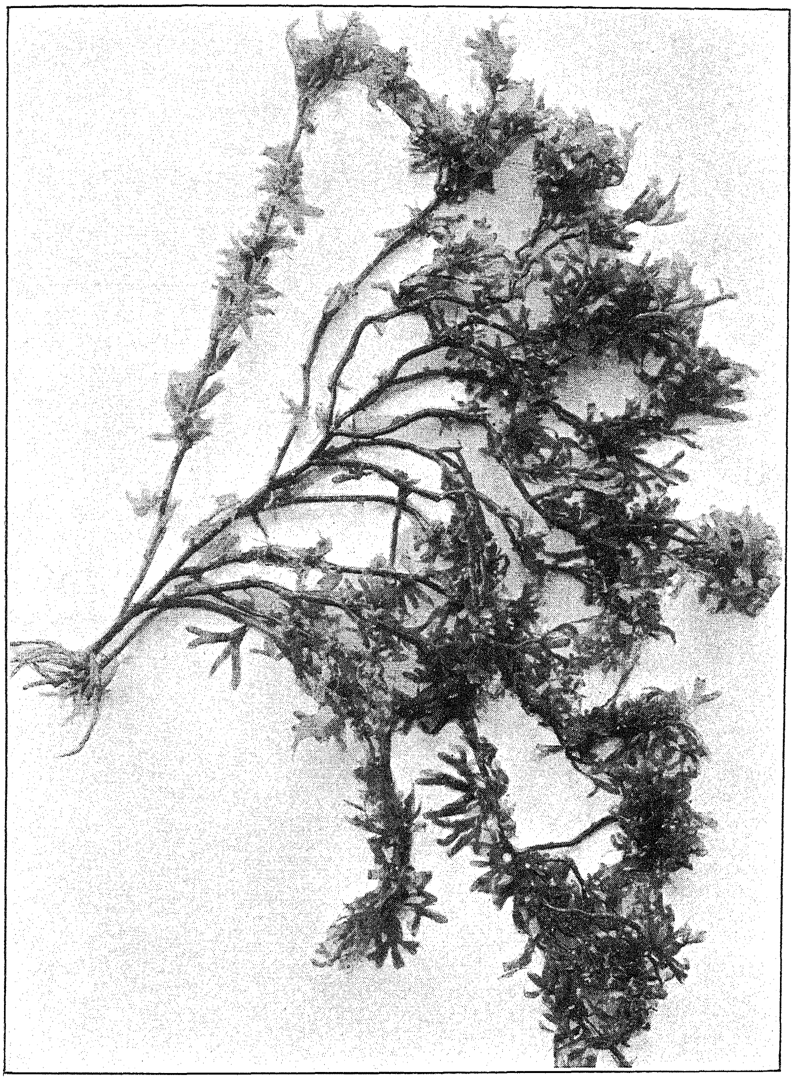


TREMATOCARPUS DICHOTOMUS Kütz.



RHODYMENIA FLABELLIFCLIA (Bory) Mont.

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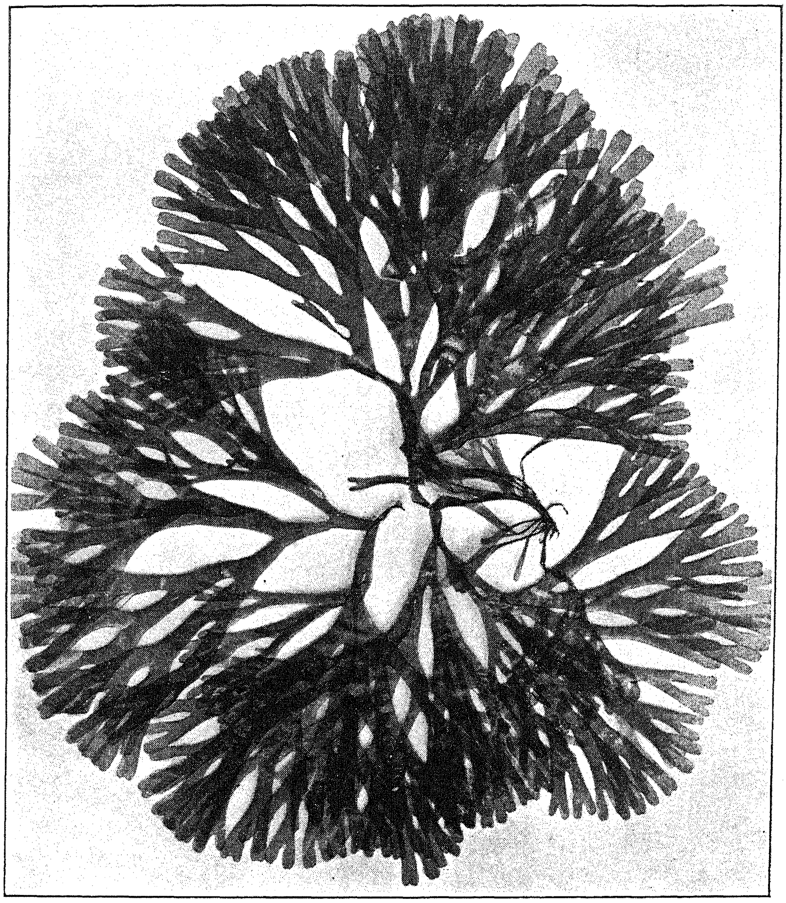
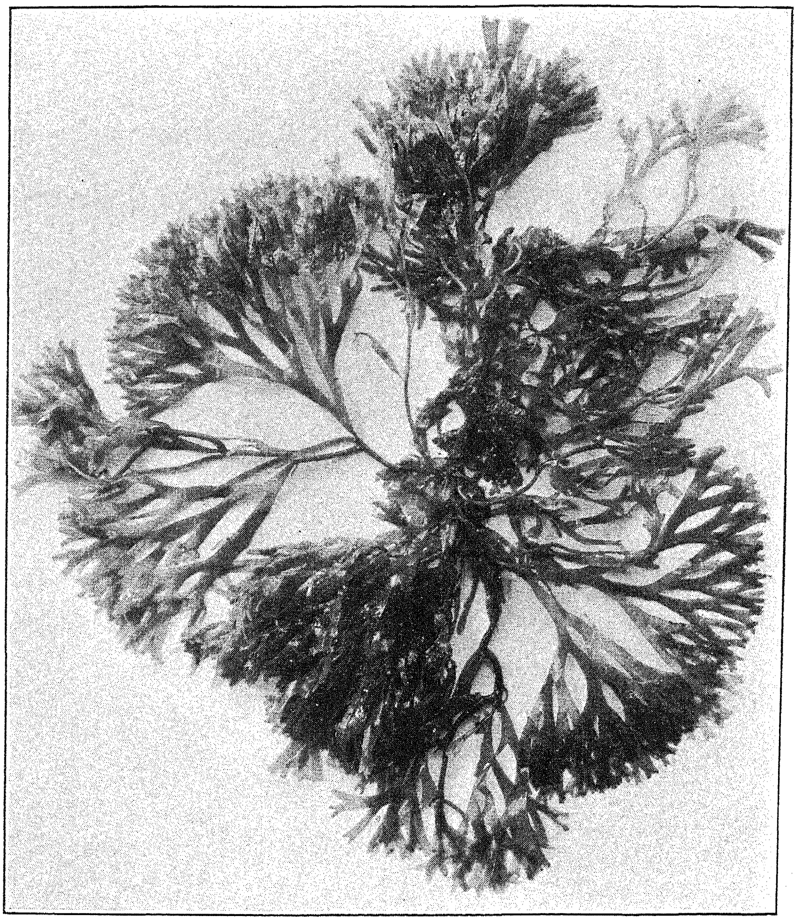


RHODYMENIA CORALLINA (Bory) Grev.



RHODYMENIA CORALLINA (Bory) Grev.

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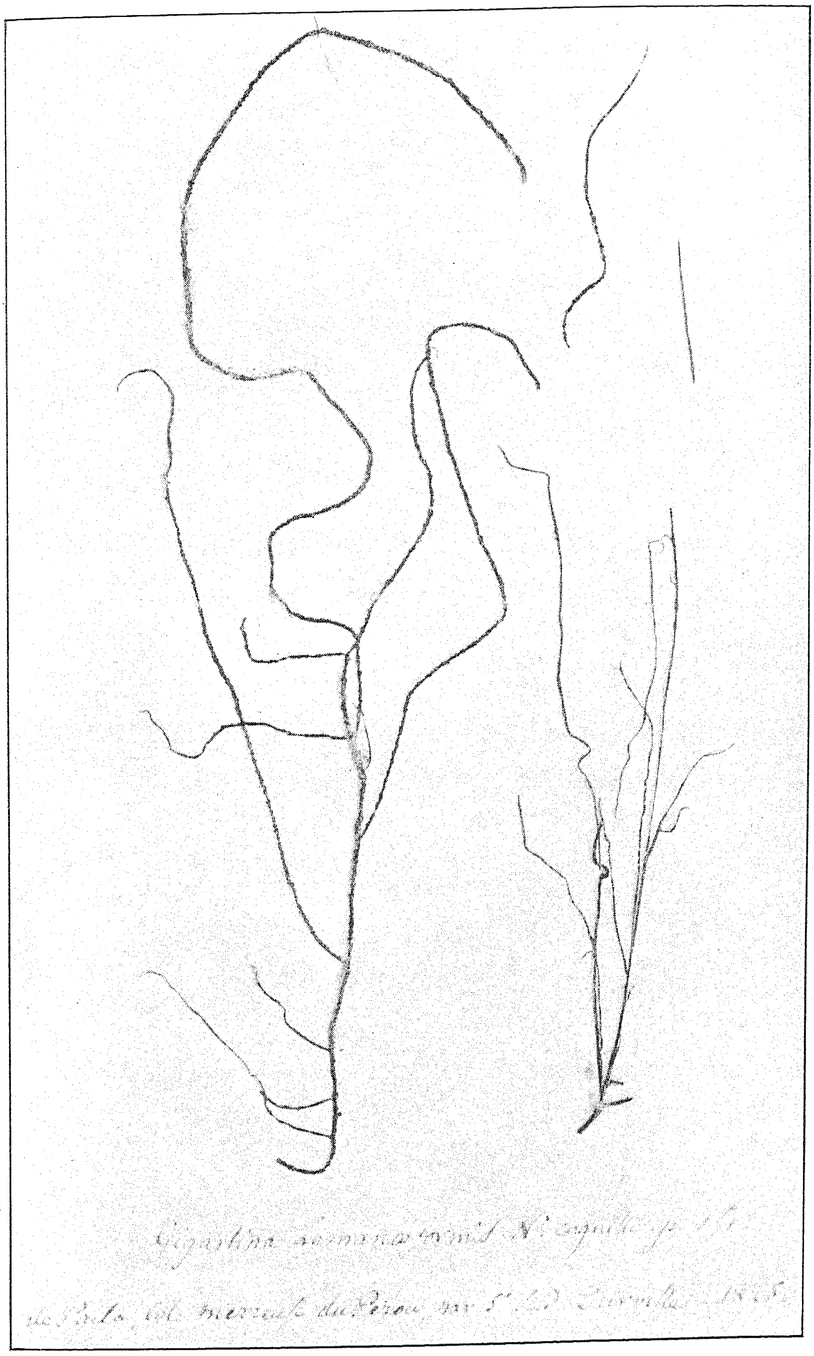

Cordylecladia lemanaeformis (Bory) M. A. Howe

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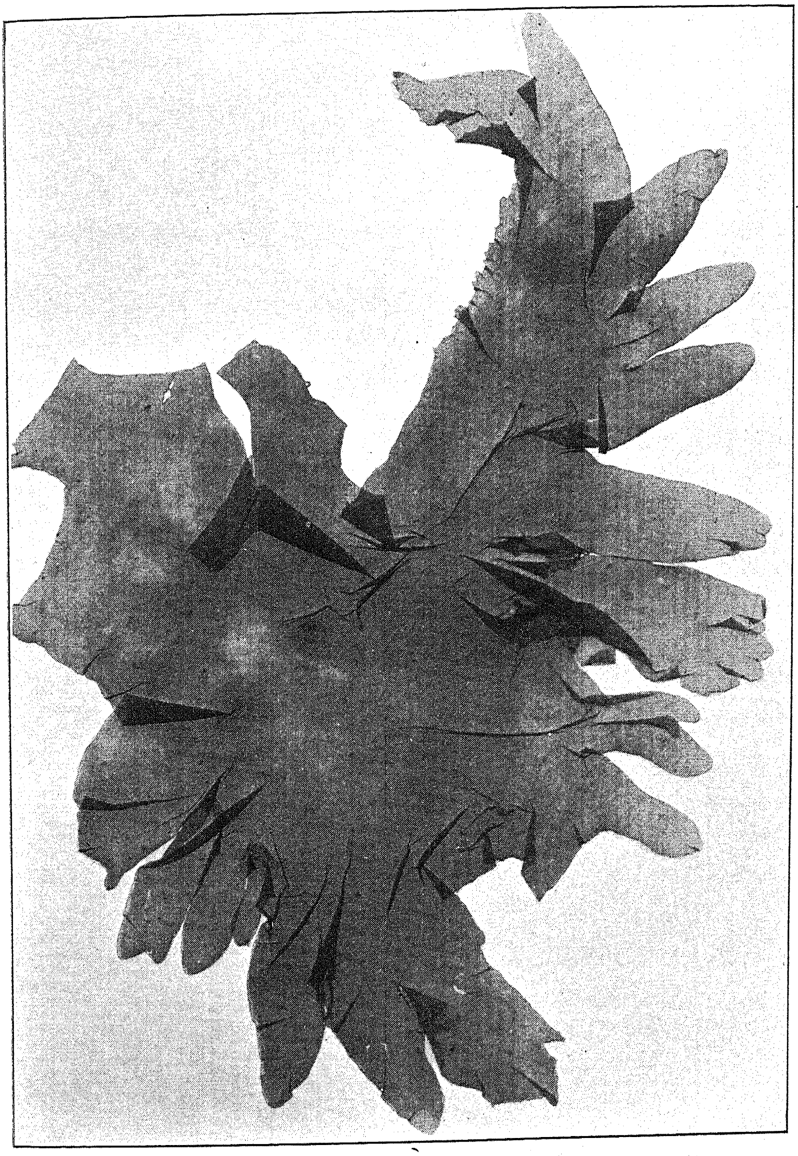
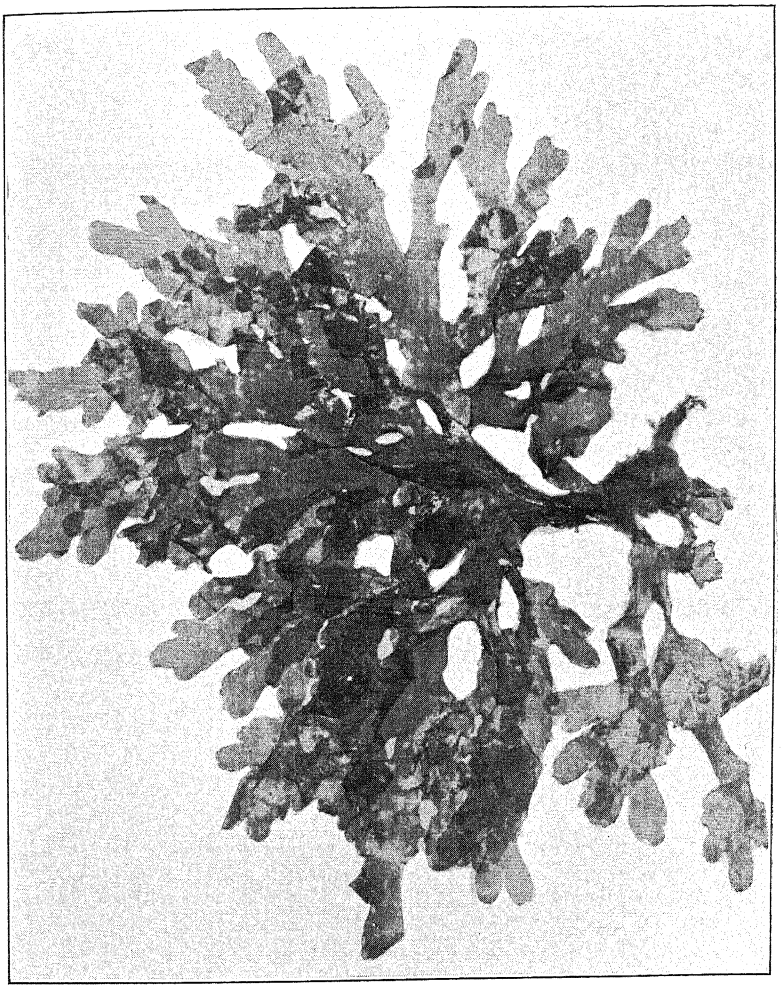


CHRYSYMENIA (?) LOBATA M. A. Howe



NITOPHYLLUM CRYPTONEURON (Mont.) De-Toni

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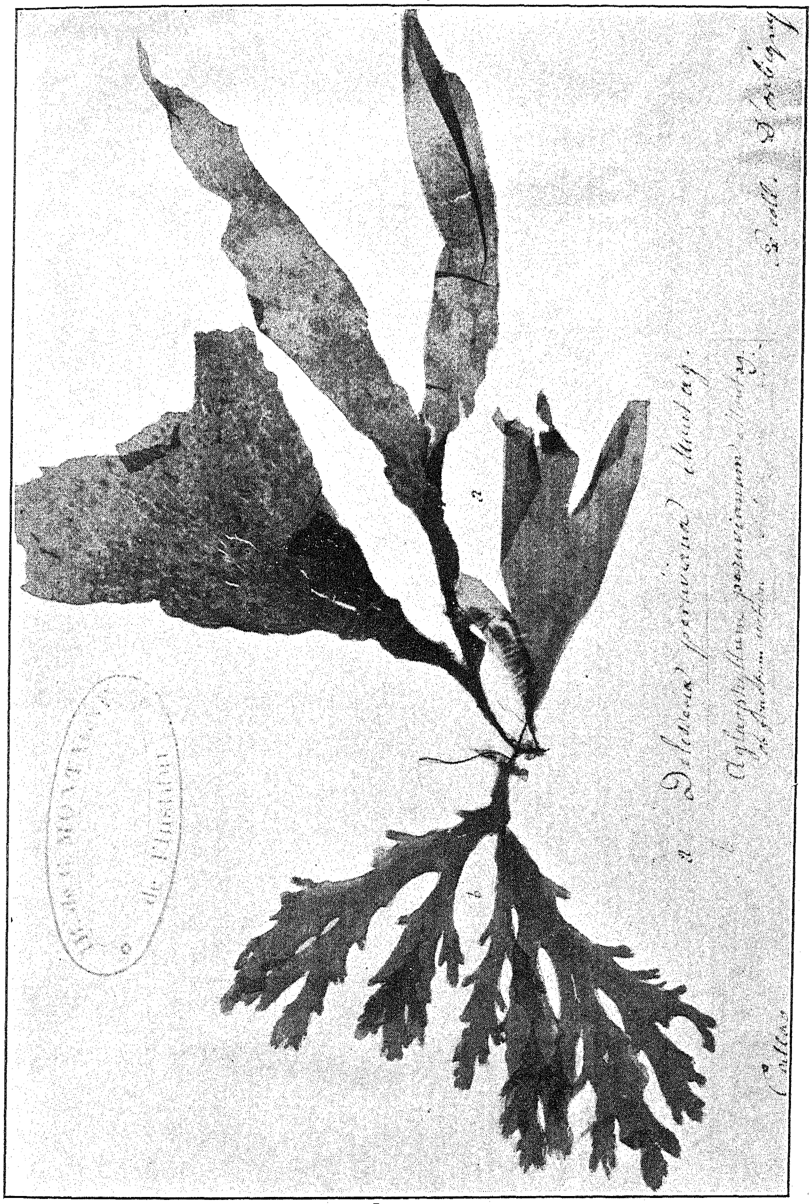

NITOPHYLLUM PERUVIANUM (Mont.) M. A. Howe

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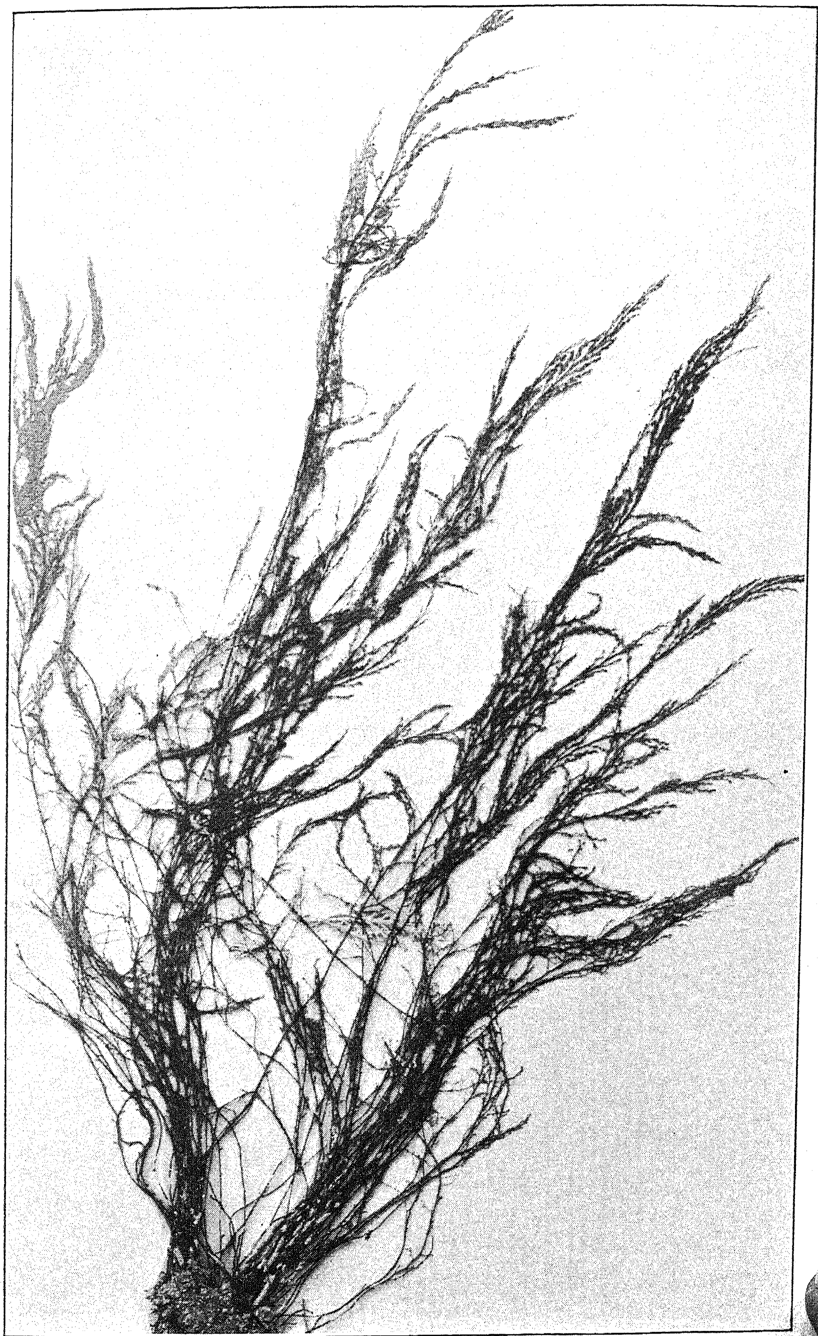

Streblocladia spicata M. A. Howe

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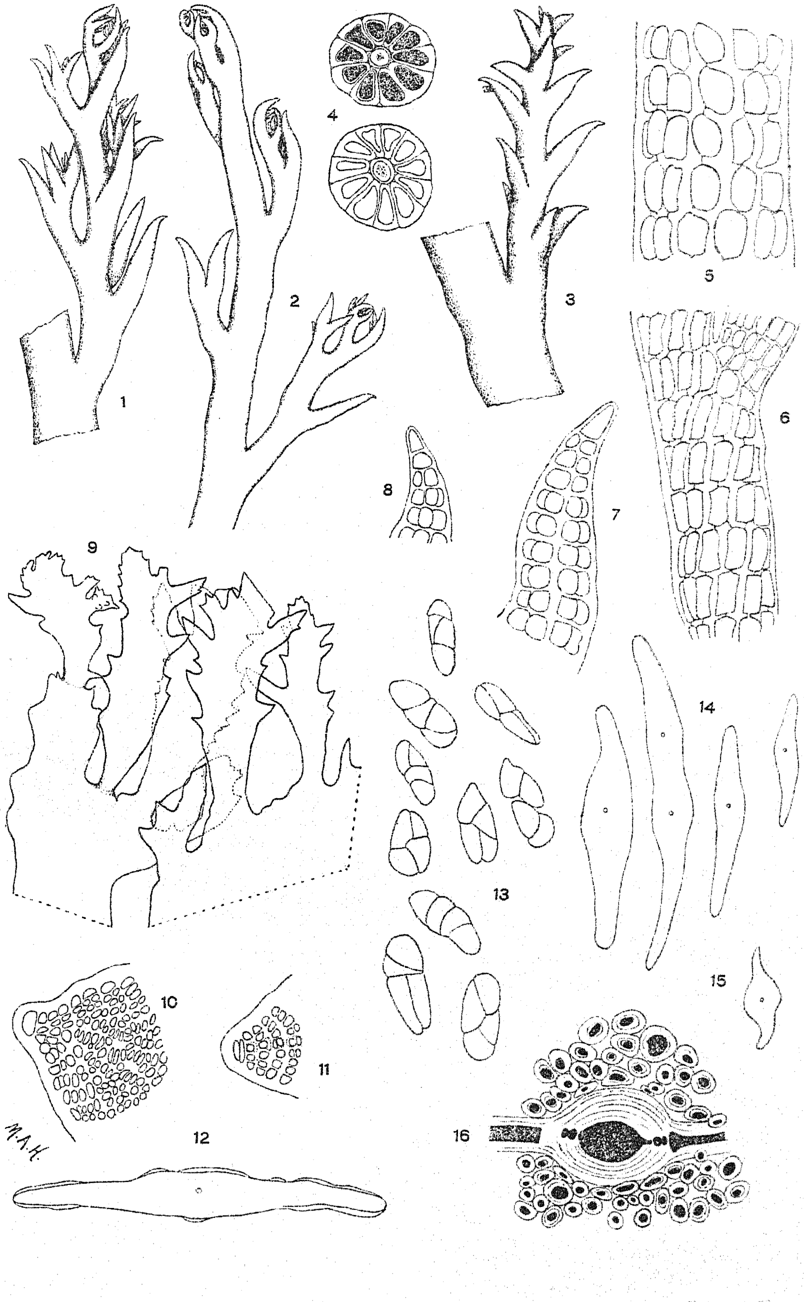

1-8. STREBLOCLADIA SPICATA M. A. Howe
9-16. LEPTOCLADIA PERUVIANA M. A. Howe

HELIOTYPE CO., BOSTON

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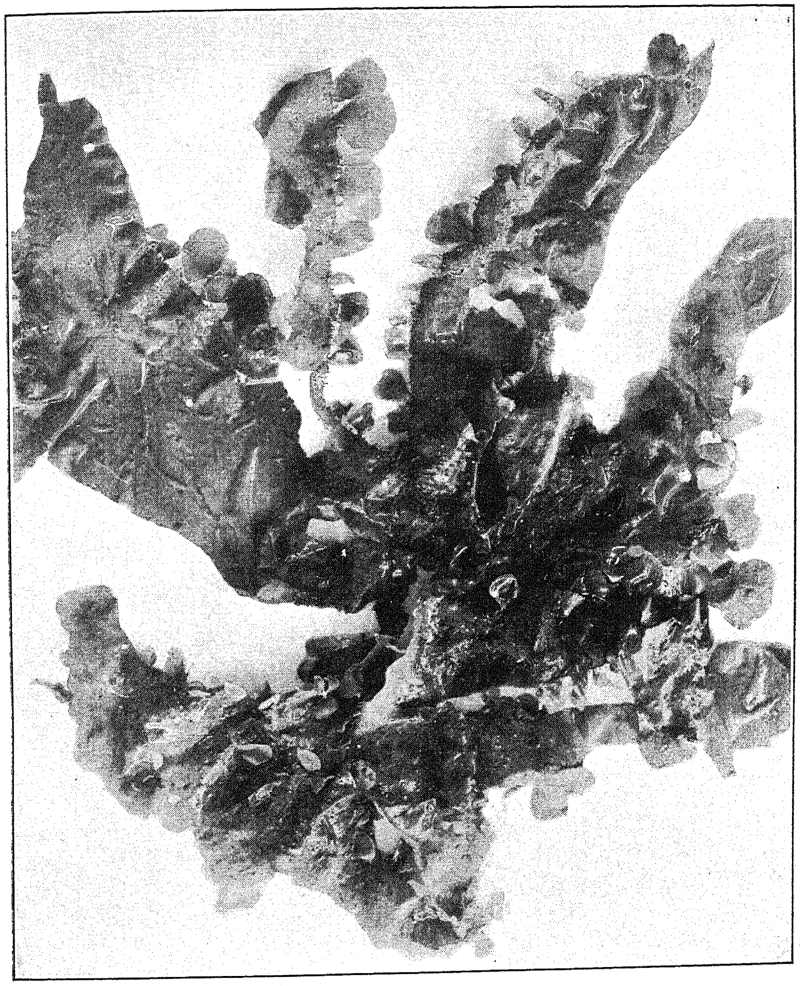
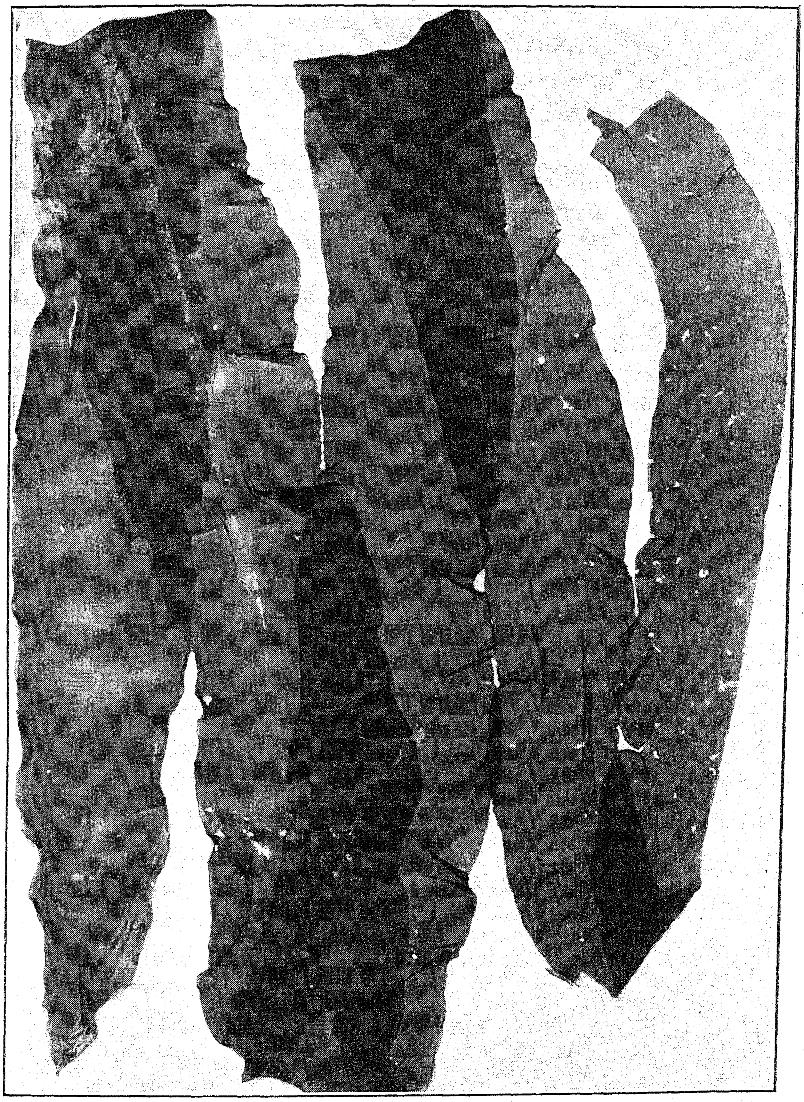


SEBDENIA HETERONEMA M. A. Howe



GRATELOUPIA CUTLERIAE PROCERA M. A. Howe

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GRATELOUPIA CUTLERIAE PROCERA M. A. Howe

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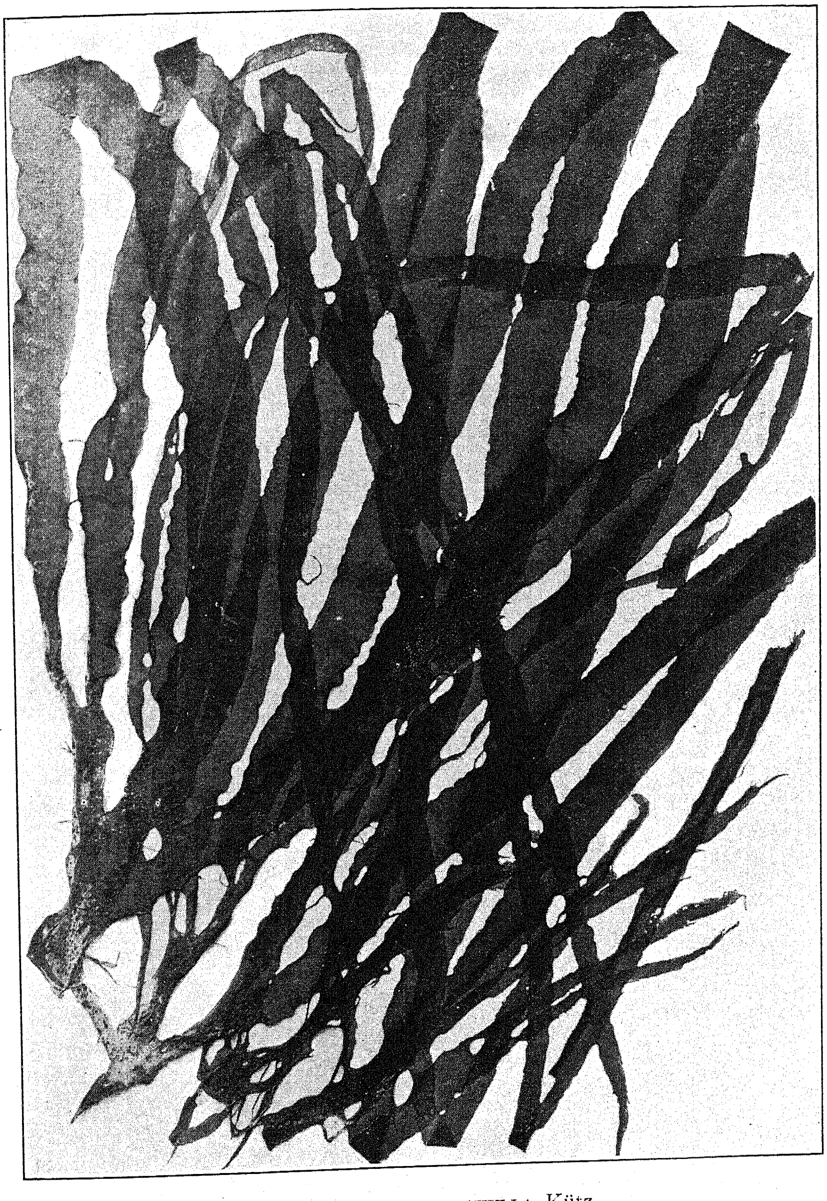

GRATELOUPIA SCHIZOPHYLLA Kütz.

CRATELOUPIA SCHIZOPHYLLA Kütz.

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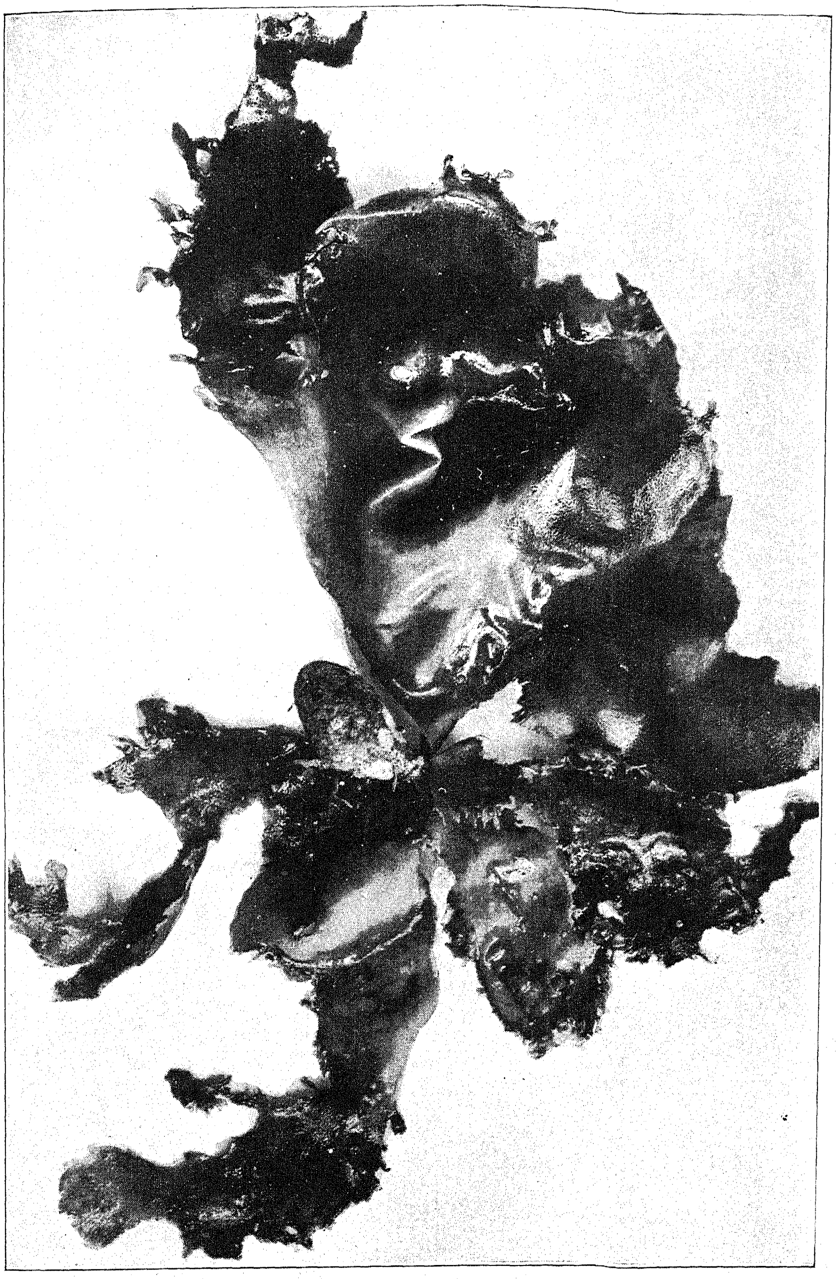
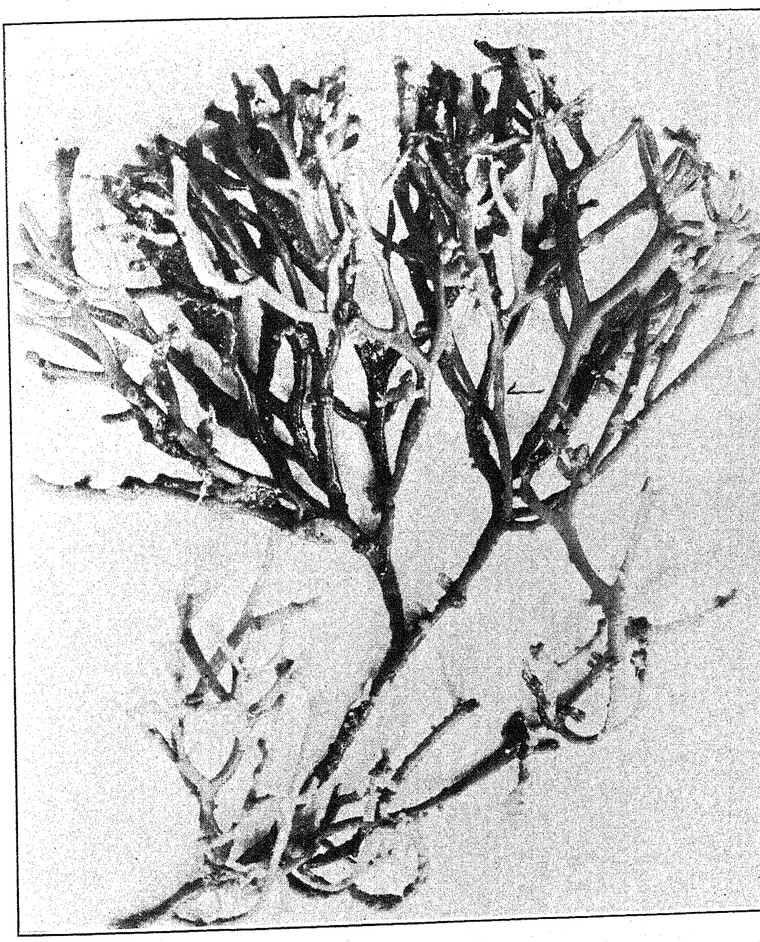
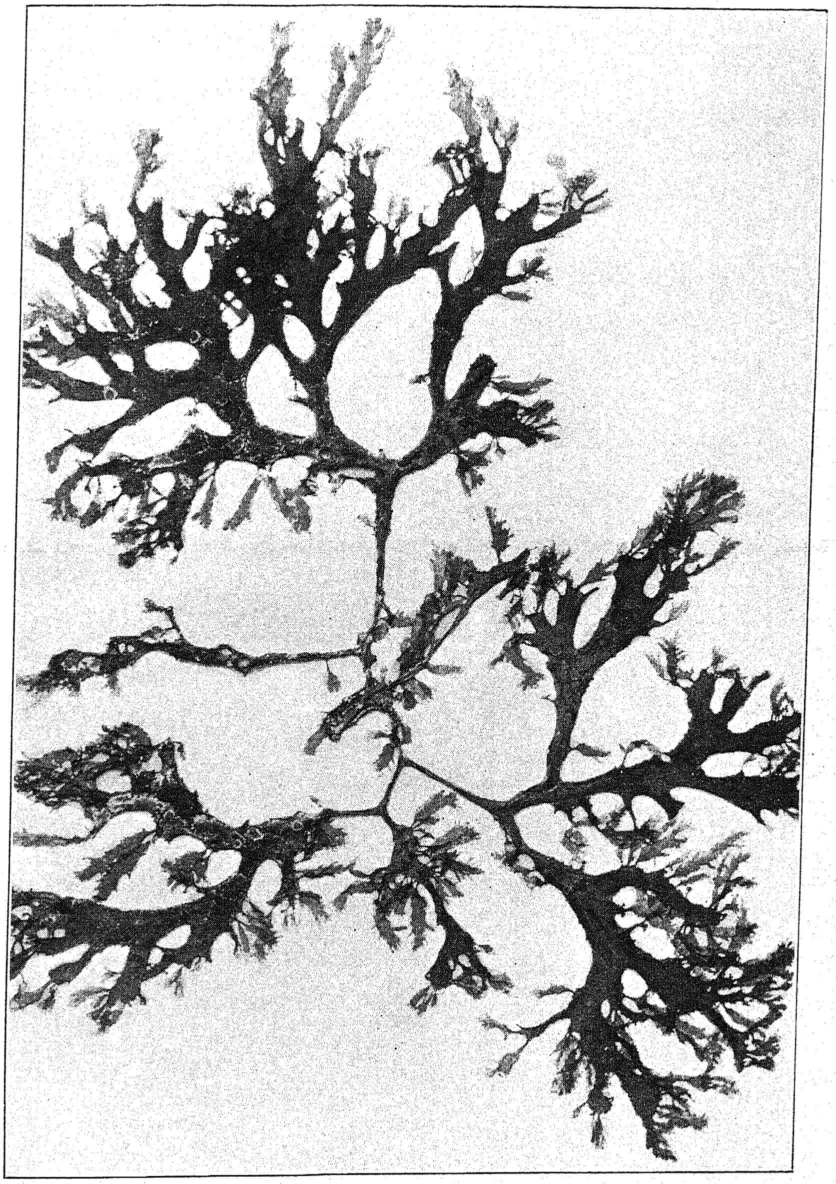


PACHYMENIA CUTICULOSA M. A. Howe

PRIONITIS DECIPIENS (Mont.) J. Ag.
and
LOBOCOLAX DEFORMANS M. A. Howe



PRIONITIS DECIPIENS (Mont.) J. Ag.
and
LOBOCOLAX DEFORMANS M. A. Howe



LEPTOCLADIA PERUVIANA M. A. Howe